JULY 1950

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

SECTION FOR recently completed vehicular tunnel at Pasadena, Tex., is ready for towing 400 miles from Pascagoula, Miss., to position in tunnel under Houston Ship Canal. See article in this issue.

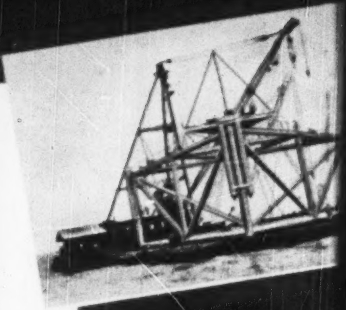
Prestressed Bridge Opened at Sclayn, Belgium—Magnel

Denver Gets More Water Through 7½-Ft Concrete Pipe—Gross

East Side-West Side Joined by Battery Underpass—Meltzer

AMERICAN SOCIETY OF CIVIL ENGINEERS
FOUNDED 1852

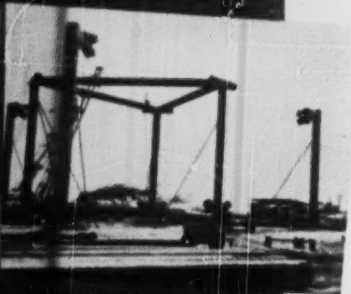
THE WORLD'S MOST UNUSUAL SOIL BORING JOB

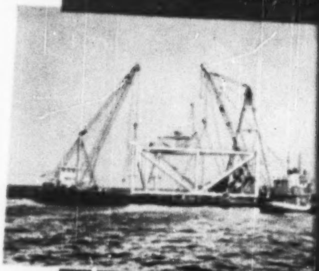


The Problem: 250-foot Gow soil borings, accurately spotted five to ten miles offshore in the deep waters of Lake Maracaibo, Venezuela. The Project: pile foundations for future oil-well derricks. Special Hazard: 70-mile-an-hour "chubascos," violent squalls that would wreck temporary platforms.

The Solution: Raymond engineers designed a triangular *floating* platform of 22" steel pipe, welded and watertight. The three corner members were left open for 120-foot-long anchor spuds. Assembled on shore from steelwork fabricated in New York, the 60-ton float was skidded onto two barges and towed 32 miles to the first boring location where floating derricks launched it. Spuds and deck equipment were placed later, including winch-controlled anchors at each corner to help in spotting the float and holding it steady during boring operations.

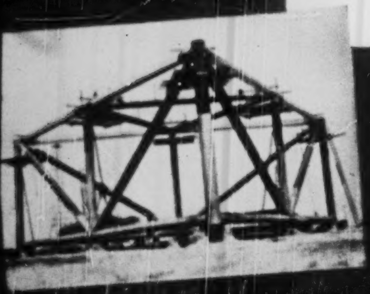
The Moral: When the problem is tough, the answer must still be *right*. That's when it pays to have a resourceful, experienced organization on the job . . . like Raymond!

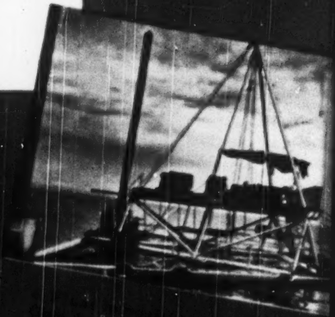




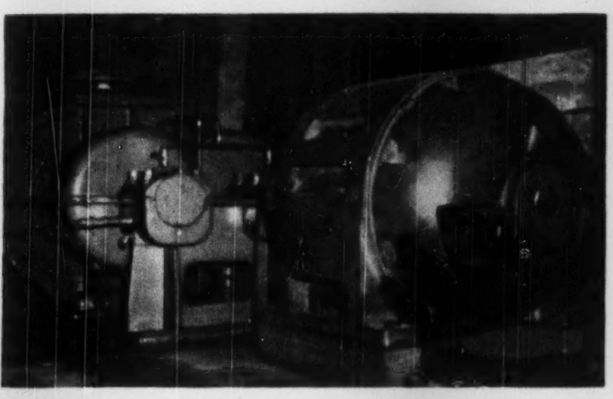
Raymond
CONCRETE PILE CO.

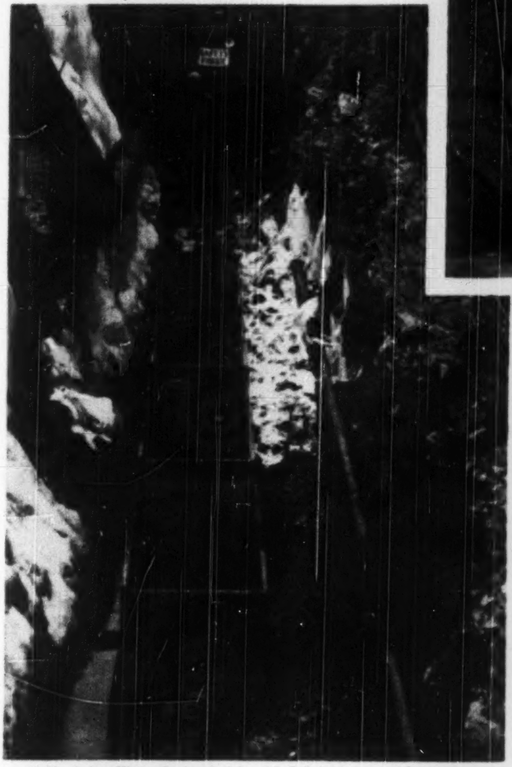
140 CEDAR STREET • NEW YORK 6, N. Y.



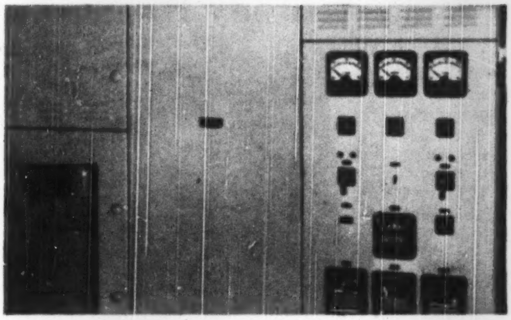


Ventilation for the Delaware Aqueduct tunnel is provided by blowers driven by sturdy G-E 200-hp induction motors. ▶





▲ **Muck is efficiently hauled by 18 G-E battery and battery-trolley locomotives.**



▲ **Adequate d-c power for trolley service is obtained from eight G-E 150-KW stationary mine-type mercury-arc rectifiers specially designed for this project.**

tunneling through the CATSKILLS

. . . *Electrically*

to bring more water to New York City

Adding 300 million gallons a day to New York City's water supply is a big job no matter how it's done. To help bring it from the Delaware River, the Walsh Construction Co. and B. Perini and Sons must bore 25 miles through the Catskill Mountains. At about 70 feet a day, they've still a long way to go, but expect to complete the job around July 1955 with *electrified* equipment co-ordinated and engineered by General Electric.

Every day, more contractors are looking to reliable *electrified* equipment for flexibility, safety, and ease of maintenance. With equipment driven by G-E motors and control, and supplied from G-E power distribution systems they get modern *electric drives* with the added advantages of G-E engineering assistance in application, installation and service. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

Electrified Construction
BETTER PRODUCT
LOWER COST

GENERAL ELECTRIC

66x-10

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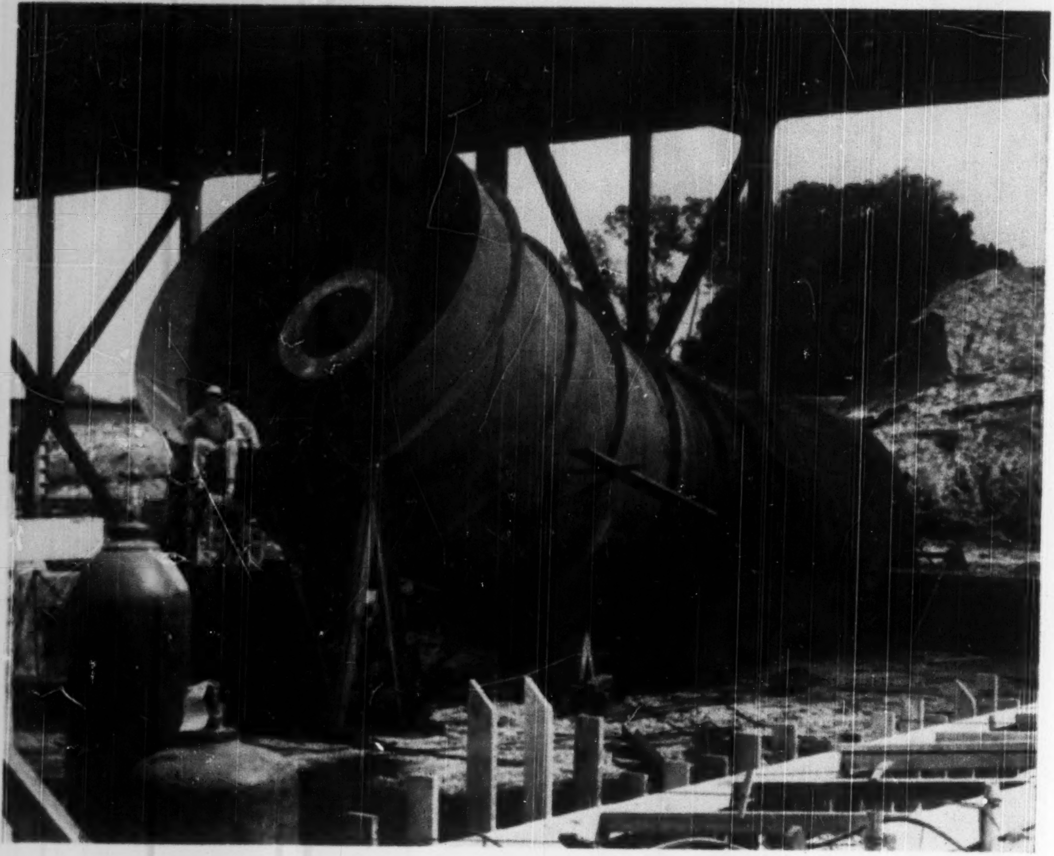

Welded Steel PENSTOCK at Whitney Dam

The above view shows the first few rings of one of the two welded penstocks we installed at the Whitney Dam on the Brazos River near Waco, Texas.

The two penstocks at this dam will deliver water to two 20,000 hp turbines. Each penstock is 16 ft. in diam. at the upper end; 14 ft. 8 in. in diam. at the lower end and is 101 ft. long. They are made of plates ranging from $^{1}/_{2}$ in. to $^{11}/_{16}$ in. in thickness. We fabricated the steel for them at our Birmingham plant and assembled the sections at the dam site.

These penstocks are being erected in blocks 8 and 9 in the west portion of the dam. The internal "spiders" shown in the above view were used to retain the circular shape of the penstock sections during handling and erection and while concrete was being poured around them. After the concrete around them set, the "spiders" were removed.

The Whitney Dam—scheduled for completion in 1952—is being installed to reduce flood damage, estimated as high as $7,500,000 annually. It is an earthfill dam, 19,600 ft. long, with a 1,674-ft. concrete section 167 ft. high. The project is being directed and supervised by the U.S. Engineers.

• • • •

Penstocks are typical examples of the type of heavy steel plate work we are equipped to fabricate and erect for civil engineering projects. We also fabricate and erect plain and differential surge tanks, smokestacks, flat-bottom reservoirs and elevated water tanks. You are invited to write our nearest office for estimates on your next job.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3 .... 2167 Healey Bldg.
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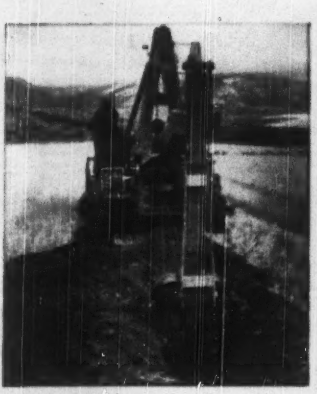
Cleveland 15 .... 2263 Guildhall Bldg.
Detroit 26 .... 1541 Lafayette Bldg.
Havana .... 402 Abreu Bldg.
Houston 2 .... 2128 National Standard Bldg.
Los Angeles 17 .. 1556 General Petroleum Bldg.
New York 6 .... 3395—165 Broadway Bldg.
Philadelphia 3 .. 1652—1700 Walnut St. Bldg.
Salt Lake City 4 .... 509 West 17th South St.
San Francisco 4 .... 1584-200 Bush St.
Seattle 1 .... 1309 Henry Bldg.
Tulsa 3 .... 1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

IMMEDIATE DELIVERY!
HYSTER
1/2 CU. YARD CAPACITY

Hystaway Hoe Front

For use with Hystaways mounted on "Caterpillar" D8, D7 and D6 track-type tractors



Ditch digging is fast and efficient with the Hystaway Hoe. A narrow trenching bucket (23-in. cutting width) is available as optional equipment. Standard 1/2 yd. bucket is 33 in. wide.

A HIGH SPEED, rugged NEW EARTH MOVING TOOL for *ditch and trench digging and basement excavating.* DOES ANY JOB that a CONVENTIONAL 1/2 cubic yard hoe can do.

The Hystaway Hoe will dig to a full 15 ft. depth. It has MORE REACH than a conventional back hoe—an EXTREMELY FAST SWING—an actual EXCESS of POWER because of the "Caterpillar" diesel tractor engine which, even on the D6, has more horsepower than the engine on the average 1/2 yd. excavator.

The Hystaway, mounted on a "Caterpillar" D8, D7 or D6 track-type tractor with bulldozer, now provides five tools—dragline, clamshell, crane, shovel and the BACK HOE—and full tractor MOBILITY AND MANEUVERABILITY are retained. Current delivery. See your "Caterpillar" distributor.

HYSTER COMPANY

2999 N. E. Clackamas . . . Portland 8, Oregon
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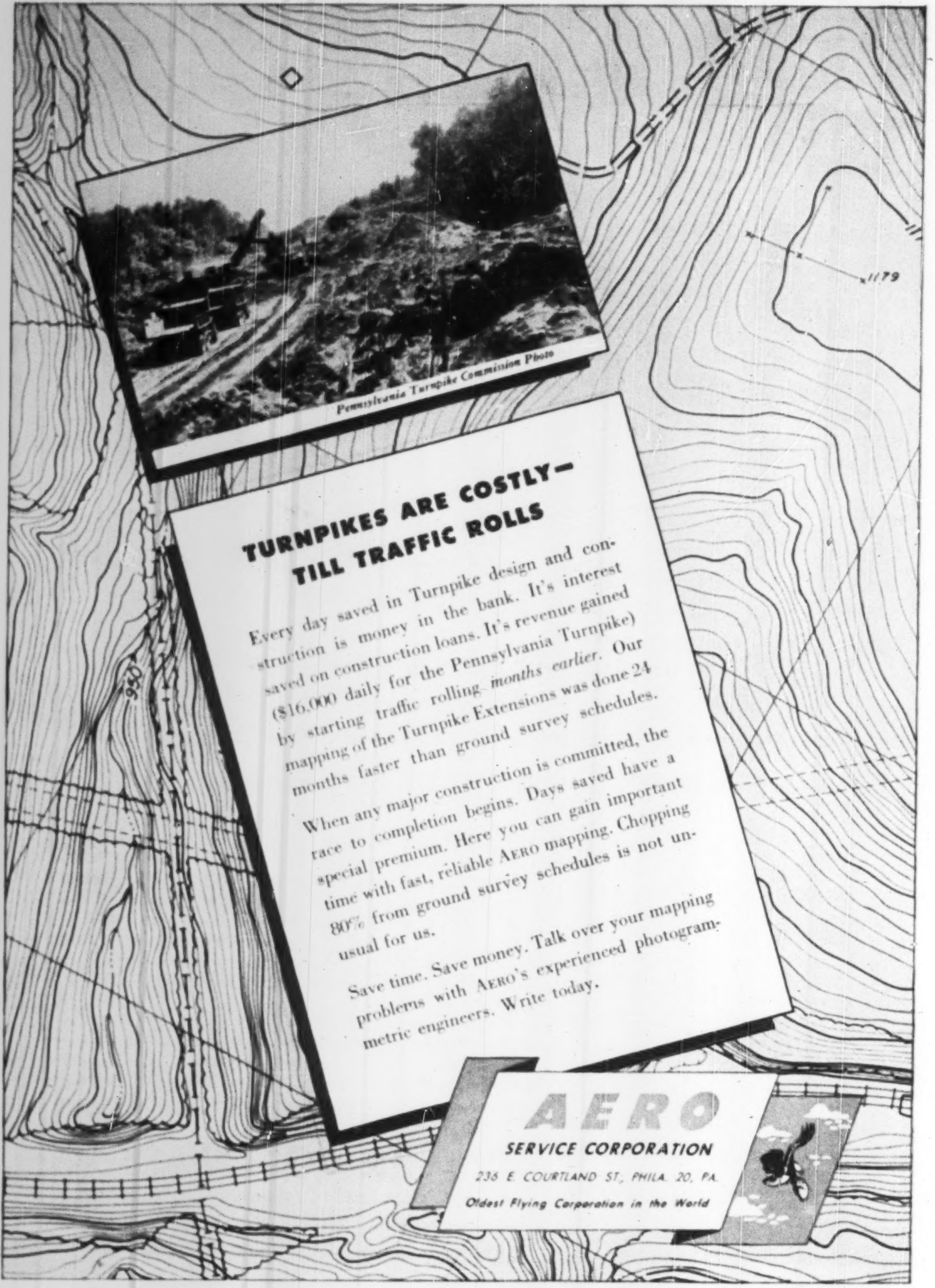

Pennsylvania Turnpike Commission Photo

TURNPIKES ARE COSTLY— TILL TRAFFIC ROLLS

Every day saved in Turnpike design and construction is money in the bank. It's interest saved on construction loans. It's revenue gained ($16,000 daily for the Pennsylvania Turnpike) by starting traffic rolling *months earlier*. Our mapping of the Turnpike Extensions was done 24 months faster than ground survey schedules.

When any major construction is committed, the race to completion begins. Days saved have a special premium. Here you can gain important time with fast, reliable AERO mapping. Chopping 80% from ground survey schedules is not unusual for us.

Save time. Save money. Talk over your mapping problems with AERO's experienced photogrammetric engineers. Write today.

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236 E. COURTLAND ST., PHILA. 20, PA.
Oldest Flying Corporation in the World

Newest Vehicular Bridge over Mississippi River

Floored with 167,000 Sq. Ft. of U·S·S I-BEAM-LOK!

Consulting Engineers, Modjeski & Masters, Harrisburg, Pa.
Contractors, Harris Structural Steel Company, New York, N. Y.

Nearly a mile long, the giant new cantilever structure spanning the broad Mississippi at Memphis is the latest vehicular bridge over this great river.

Designed to take ample care of both present and foreseeable future heavy, high-speed traffic, this wide four-lane bridge (officially named the Memphis and Arkansas Bridge) has two 24-ft. roadways of concrete-filled U·S·S I-BEAM-LOK Steel Flooring extending 3,694 ft. of its length with a total of 167,000 square feet.

The selection of U·S·S I-BEAM-LOK for this big bridge further indicates the overall economies resulting from the use of this type of lightweight steel flooring. Leading bridge and highway engineers continue to prefer U·S·S Armored I-BEAM-LOK where it is necessary to reduce the cost of foundations and super-structure.

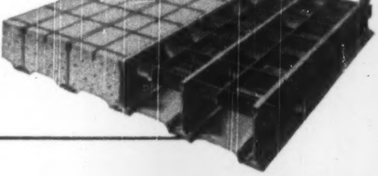
Not only does the concrete-filled grid of I-BEAM-LOK provide a smooth-riding, safe, skid-resisting, fire-proof and long-life surface, but it requires less maintenance than other flooring. Furthermore, it can be erected easily and speedily. In the re-flooring of existing bridges, its lightweight and great strength often make it possible to increase H-load ratings without major changes in existing bridge structures, and interruption of traffic is held to a minimum.

U·S·S I-BEAM-LOK is available in both concrete-filled and open types. The concrete-filled type comes in 3" and 4¼" sizes and in weights of only 47 and 55 lbs. per sq. ft. The open type is even lighter, it weighs approximately 18.9 lbs. per sq. ft. as installed.

To find out more about this "modern floor for modern traffic," contact the office nearest you. Our engineers will be glad to discuss its possibilities with you.

U·S·S I-Beam-Lok combines all of these important Advantages

1. **VERY LIGHT UNIT WEIGHT**, thus reducing dead load and the ultimate cost of completed bridge.
2. **GREATER RIGIDITY OF ENTIRE ROADWAY**. Positive connection between slab and stringers.
3. **EASE OF ERECTION**, with no concrete forms necessary. Saves time in completion of structure.
4. **SMOOTH HARD SURFACE** for safe, high-speed traffic.
5. **LOW MAINTENANCE COST**. Bridge floors of U·S·S Armored I-Beam-Lok have averaged 12 to 14 years of heavy use before the surface required any maintenance.



CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH · COLUMBIA STEEL COMPANY, SAN FRANCISCO
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USS

U·S·S I-BEAM-LOK STEEL FLOORING

0-1140

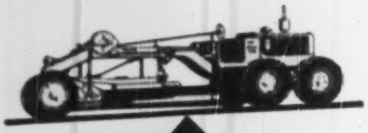
UNITED STATES STEEL

This Klock Construction Company's "Cat" No. 212 Grader is grading for sidewalk at the municipal football stadium in Amarillo, Texas. Does subgrade, shoulder work and drainage. D. W. Klock says, "This rig is the backbone of our street, alley and parking area work in Amarillo. It's well balanced, and just the right size. Going to buy another just like it this year!"

Price of the standard model No. 212 Motor Grader is $6435, f.o.b. Peoria, subject to change without notice.

Buy balanced "Cat" Graders

for more work at less cost



SPEED
WEIGHT
POWER

CATERPILLAR

DIESEL ENGINES · TRACTORS · MOTOR GRADERS
EARTHMOVING EQUIPMENT

The "Cat" No. 212 Grader shown here will never be a wallflower. Owner D. W. Klock, Amarillo, Texas, says, "This rig's so well balanced, maneuverable and fast, the boys all want to run it!"

Balance is the secret of "Cat" Graders' popularity with owner and operator alike. "Caterpillar" builds each Motor Grader from the ground up as an individual unit. The correct weight, plus the right horsepower, plus rated work speed – these things add up to *balanced* machines that solve your job problems at lower cost.

Informed buyers are finding that *assembled* graders are often poorly balanced. It stands to reason that when one engine or one frame is used for more than one model, the best use cannot be made of weight and power. But balanced "Cat" rigs are neither muscle-bound nor jumpy on the job, and cut costs through superior performance and longer service life.

There's a size "Cat" Motor Grader for every type of work – with the stamina, punch and balance to do a particular job best. And don't forget what world-famous "Caterpillar" dealer service means in cutting down time to the bone. Their representatives have plenty of job-savvy, and their parts replacement service is without an equal. Ask your "Caterpillar" dealer to show you his Motor Graders' bonus features. And remember that quality under the hide doesn't show on the outside – it shows up in performance.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

Bitumuls HV

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High Viscosity
Asphaltic Emulsion
for Surface Treatment

Another Product
Pioneered By
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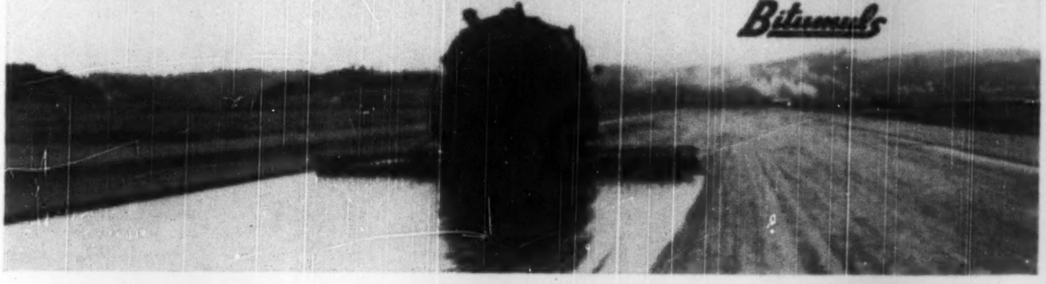


QUIZ for Paving Engineers

How do YOU answer these questions?

1. **Can you hold wet, round gravel or large aggregate with your present binder?**
2. **Does your binder stay on the road, when "shooting" a steep grade or high crown?**
3. **Are your surface treatments rugged, non-skid, and vapor-permeable?**

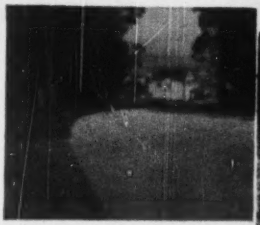
If your answer to all three questions is "Yes", you must be using *Bitumuls HV*—a "High Viscosity" asphaltic emulsion that is now used by a majority of State Highway engineers, because it really holds the aggregate, large or small, wet or dry.

Precise application is easy. No excess binder to cause fatness or slippery pavements—or to act as a vapor barrier retarding drainage by upward evaporation. You get a non-skid, vapor-permeable seal.

If You have not used "HV", try it on one job—you, too, will adopt it.

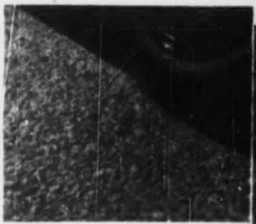
1. Stone Held?

—or Ravels?



2. Binder stays put?

—or Runs Off?



3. Rugged & Non-skid?

—or Fat & Slippery?

©S.A.&B.CO.

The ASPHALT Twins

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STANCAL ASPHALT & BITUMULS COMPANY
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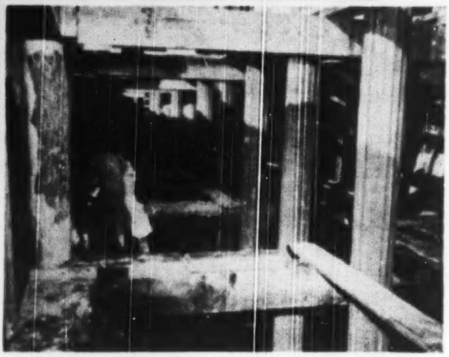
- **Bitumuls for Maintenance** . . . . ☐
- **Bitumuls Sand-Mix** . . . . . . ☐
- **Bitumuls Handbook** . . . . . . ☐
- **Hydropel**—Admix for concrete . . . ☐
- **Tennis Courts**—Laykold & Grasstex . ☐
- **Fibrecoat**—roof and metal coating . ☐

Fast simplified driving of 70-foot Monotube Piles for pier under Boston side of Eliot Bridge.

No danger to this cofferdam



Note excellent alignment of Monotube piles. Extremely close tolerances alongside bracing and sheet piling made it imperative that there be no "walking" or lateral movement under hard driving.

PICTURED here is another difficult bridge-building job where Monotube Piles helped by greatly simplifying the problems of water work. The job is the Eliot Bridge, Cambridge, Massachusetts. It is to be a beautiful 3-span bridge, 418 feet in over-all length, 83 feet wide. It will have two 30-foot roadways, separated by a 4-foot median strip, with 8-foot sidewalks.

Following construction of the cofferdams, the 70-ft. Monotube Steel Piles were driven safely, swiftly and smoothly—78 for each pier. Neither the hazards of water, nor the blue clay—sand—gravel river bed, were problems for the Monotubes . . . as evidenced by easy, top-to-bottom inspection after driving.

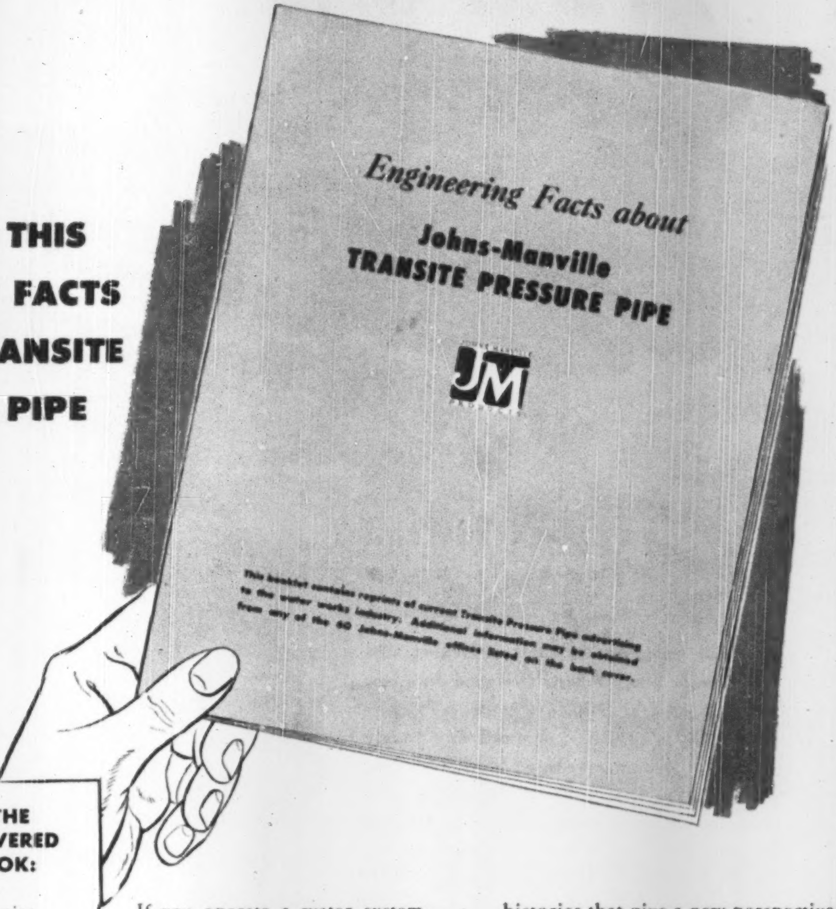
You can't afford to disturb the bracing or the alignment on a cofferdam as large as this. The *light,* sturdy Monotubes were safely placed in templates nailed to the cofferdam bracing. They were then driven to their high bearing loads without any fear of "walking" which might easily result in excessive deflection of the bracing, or even the cofferdam itself.

Monotube piles have extra advantages that can help reduce foundation costs while simplifying sound construction from start to finish. Monotubes are available in lengths, gauges, sizes and tapers to meet varying soil conditions. For complete information, write The Union Metal Manufacturing Company, Canton 5, Ohio.

UNION METAL

Monotube Foundation Piles

SEND FOR THIS DIGEST OF FACTS ABOUT TRANSITE PRESSURE PIPE



SOME OF THE SUBJECTS COVERED IN THIS BOOK:

- Installation Economies
- Carrying Capacity
- The Simplex Coupling
- Making Service Connections
- Resistance to Corrosion —an Index of Long Life
- Case Histories
- Dimensions and other useful data

If you operate a water system . . . or are concerned with the design or construction of water works projects you'll find this digest of facts about Johns-Manville Transite* Pressure Pipe helpful.

A compilation of the advertisements in our current "Engineering Facts" series, it presents concise, factual information about Transite's many economic and engineering advantages . . . includes informative case histories that give a new perspective on how this asbestos-cement pipe meets today's requirements for a modern, efficient water carrier.

In addition, it contains dimensions and other useful data about Transite Pressure Pipe which you'll want to have in your files. A copy is yours for the asking. Write Johns-Manville, Box 290, New York 16, N. Y. or use the coupon below.

*Transite is a registered Johns-Manville trade mark

Johns-Manville
TRANSITE PRESSURE PIPE

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Box 290, New York 16, N. Y.

Send me a copy of "Engineering Facts about Johns-Manville Transite Pressure Pipe" (TR-78A).

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Organization ....

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CE-7

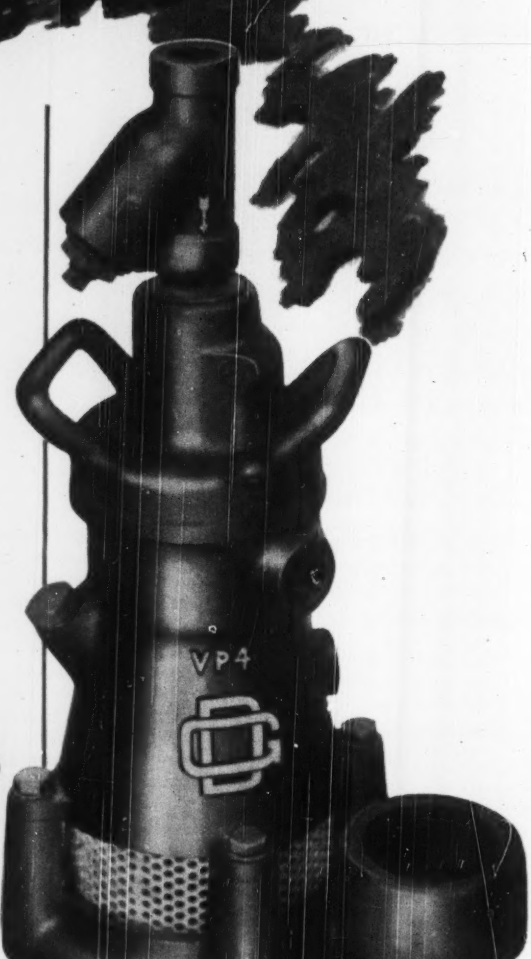
NEEDS NO MUD PROTECTION . . .

GARDNER-DENVER
VP4 SUMP PUMP

Mud can't hurt the Gardner-Denver VP4 Pneumatic Sump Pump. Designed on a new principle of TOP-SUCTION—the VP4 can't "dig in"—won't bury itself in a muddy sump—won't block inlet flow. Top-suction also eliminates one of the most common causes of pump failure—breaking of the pump shaft seal because of water pressure. *Top-suction* keeps all dirt and water away from the oil seal, bearings and air motor—actually pulls lubricant into the seal. Write for complete information about this *better* sump pump.

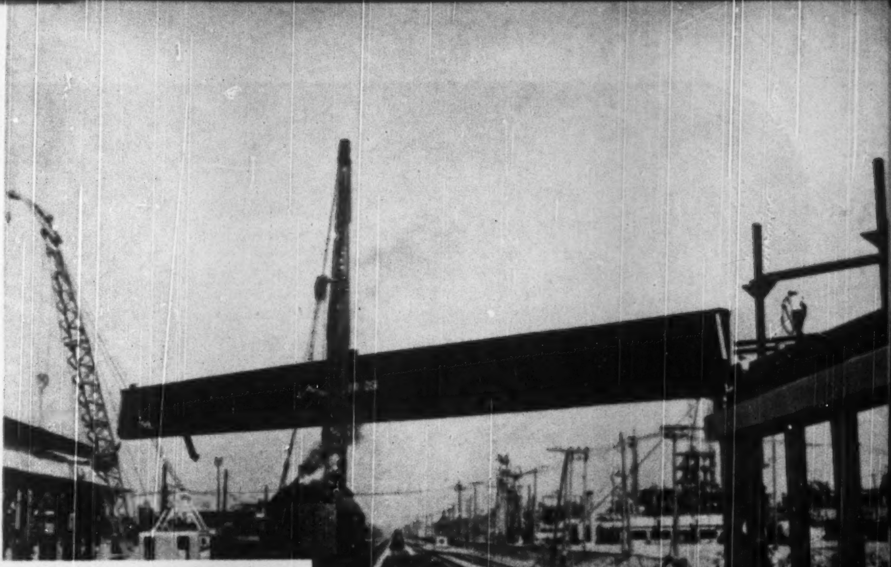
GARDNER-DENVER
Since 1859

Gardner-Denver Company, Quincy, Illinois
In Canada:
Gardner-Denver Company (Canada) Ltd., Toronto, Ontario

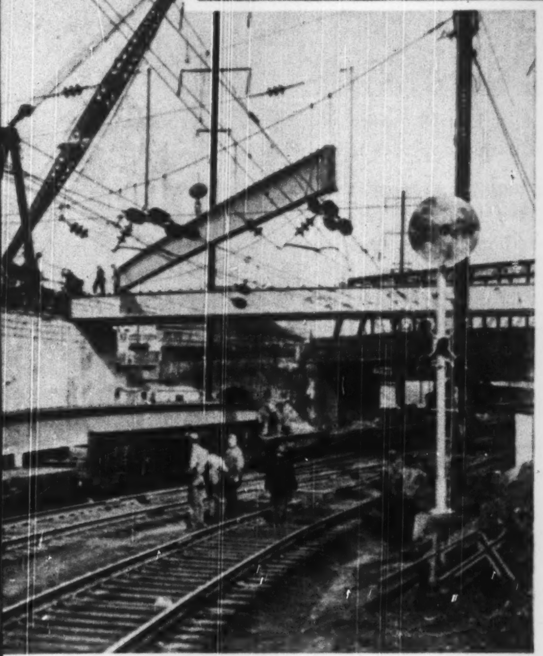


American Bridge erects an 88-ton, 140' long plate girder span over the Chesapeake and Ohio Railway tracks in the yards of The Dow Chemical Company, Midland, Michigan. This structure was erected without hindering rail traffic. Darin & Armstrong, Inc., General Contractors; L. W. Millard, Consulting Engineer.

Erecting highway overpass above the Pennsylvania Railroad tracks, New York Division, Mercer County, Trenton, New Jersey. Despite the maze of electric transmission lines surrounding the work, and the rail traffic below, American Bridge completed the job successfully, without interruption to traffic. Kaufman Construction Company, Contractors; Designed by New Jersey State Highway Department.



FABRICATED AND ERECTED BY
AMERICAN BRIDGE COMPANY
AMERICAN BRIDGE COMPANY
USS
UNITED STATES STEEL



When erection will be under difficulties —it's a job for American Bridge

● We offer the erection of the plate girder span over the Chesapeake and Ohio Railway tracks at Midland, Michigan—and the erection of the highway overpass above the Pennsylvania Railroad tracks at Trenton, New Jersey, as substantial proof of this fact:

Regardless of how complex or difficult your job may be, you can be sure it will be done right if you call on American Bridge.

AMERICAN BRIDGE COMPANY
General Offices: Frick Building, Pittsburgh, Pa.
Contracting Offices in: AMBRIDGE · BALTIMORE · BOSTON · CHICAGO · CINCINNATI · CLEVELAND
DENVER · DETROIT · DULUTH · ELMIRA · GARY · MINNEAPOLIS · NEW YORK · PHILADELPHIA
PITTSBURGH · PORTLAND, ORE. · ST. LOUIS · SAN FRANCISCO · TRENTON
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN BRIDGE
UNITED STATES STEEL

Memphis uses economical
CONCRETE PIPE
to drain Municipal Airport

SINCE 1929, Memphis has been improving and expanding its Municipal Airport. It has grown in size from 200 to 850 acres and passenger traffic has increased from about 38,000 in 1938 to approximately 400,000 in 1948.

The latest project in this development program consists of (1) a 230 ft. extension of two existing 108-in. parallel concrete pipe lines and (2) a third 108-in. concrete pipe line paralleling the entire 760 ft. length of the first two. This triple barrel concrete drainage line is designed to carry the northerly flow of Hurricane Creek under the new extension of the east-west runway.

The 108-in. reinforced concrete pipe is extra strength and was manufactured under ASTM specifications C76-41. Walls of the units are 9 in. thick. Test cylinders of the concrete pipe have shown 5,000 pound concrete in seven days.

During this expansion program many miles of economical concrete pipe storm sewers have been installed to replace open drainage ditches. Concrete pipe lines in this vast drainage system now range in size from 6 in. (for subdrainage under runways) to 108 in. and can handle as much as 2 in. of rainfall per hour.

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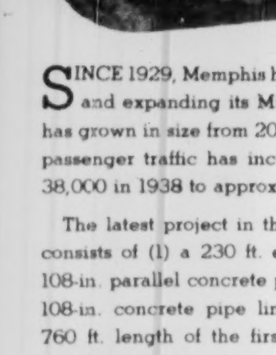

Above: Laying and backfilling triple barrel reinforced concrete pipe storm sewer in expansion of Memphis Municipal Airport.

Left: A section of 108-in. extra strength concrete pipe used in Memphis Airport storm sewer project shown in above photo.

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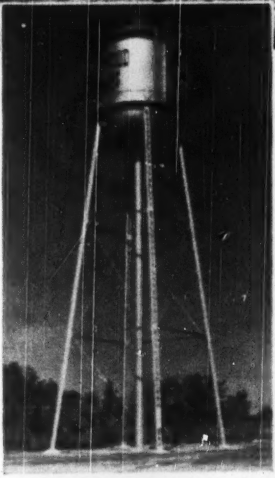

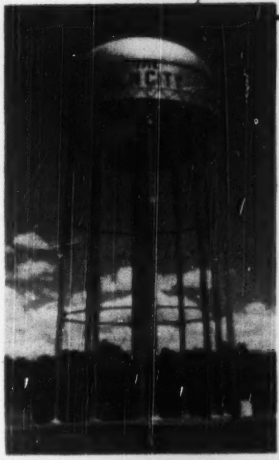

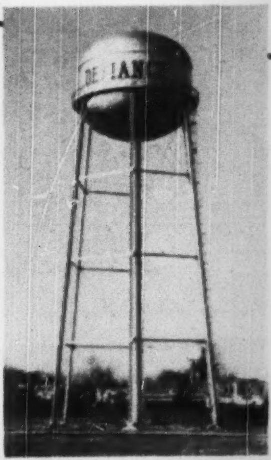

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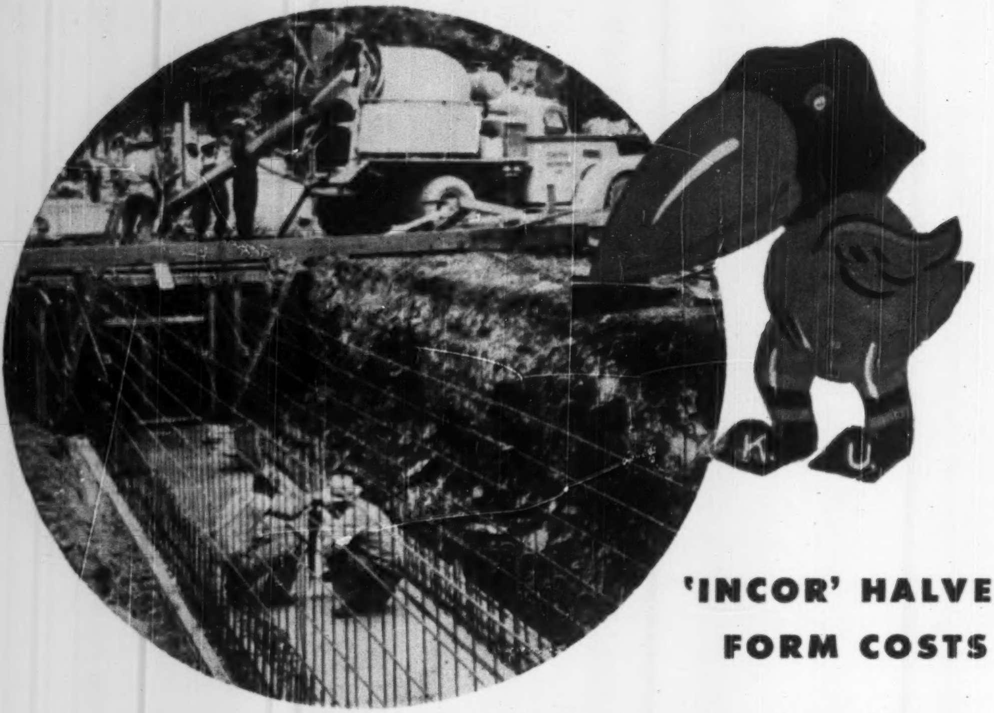

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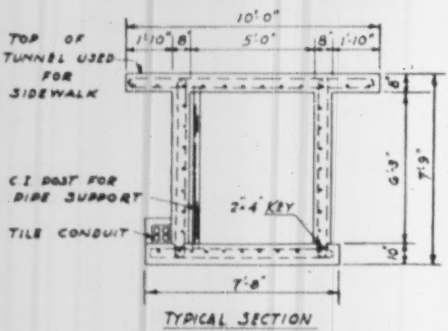
10'-0"
1'-10"
8"
5'-0"
8"
1'-10"
TOP OF TUNNEL USED FOR SIDEWALK
6"
6'-3"
7'-9"
C.I. POST FOR PIPE SUPPORT
2×4 KEY
TILE CONDUIT
10"
7'-8"

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TOTAL LENGTH – 1210 FEET

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VOLUME 20 NUMBER 7

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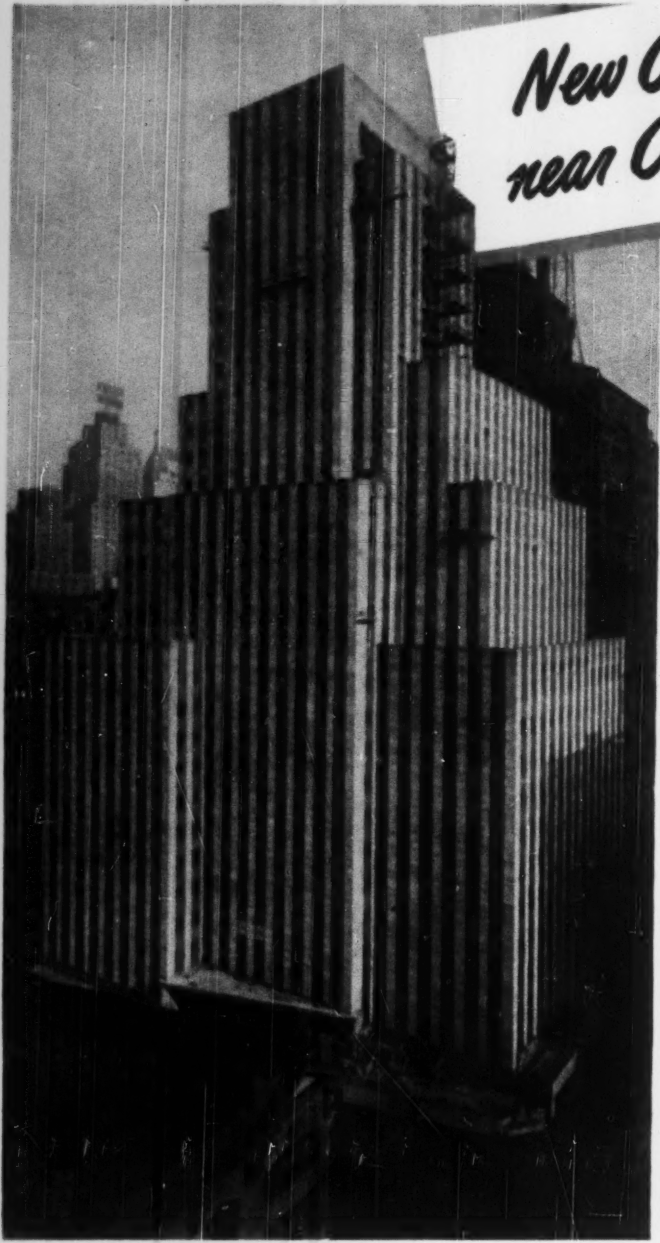
New Office Building near Columbus Circle



This new baby skyscraper, on Broadway, between 55th and 56th Streets in New York's Columbus Circle district, was built recently to provide a large, flexible working space for the approximately 2000 employees of the Mutual Life Insurance Company of New York.

The 25-story, air-conditioned structure contains 575,000 sq ft of floor space. Its 2nd to 13th stories are to be utilized by the insurance firm, and the remaining floors will be rentable. The 153 ft x 210 ft building has a facing of limestone, aluminum spandrels and stainless steel trim, and is constructed with set-backs at the 9th, 11th, 13th, 20th, and 22nd floor levels. Its sidewalk will be kept free of snow and ice during winter months by means of heated anti-freeze, circulating through coils of Bethlehem Rayduct steel pipe which are embedded in the concrete.

To build this new member of New York's growing family of notable structures, Bethlehem was called upon for the fabrication and erection of some 6500 tons of steel.

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BETHLEHEM STEEL

FABRICATED STEEL CONSTRUCTION

Denver Completes 90-Inch Concrete Conduit

D. D. GROSS, M. ASCE

Chief Engineer, Board of Water Commissioners, City and County of Denver, Colo.

TEN MILES OF 90-in. concrete pipe conduit, including a 3,005-ft tunnel section, was completed and placed in service March 8, 1950, as a part of Denver's water supply system. The position of the new conduit, No. 20, in Denver's water supply system can be seen in Fig. 1. This conduit extends from the mouth of Platte Canyon, 22 miles southwest of Denver's business section, to Marston Lake Reservoir, 3½ miles southwest of the Denver city limits. The conduit replaces two old and inadequate wood stave conduits and part of a third. At the upstream end of the new conduit a section of old pipeline, known as Conduit No. 8, has been repaired and retained in service for the present. This 60-in. wood stave pipe, constructed in 1912, extends 8,000 ft on up the canyon to the intake which diverts water from the South Platte River.

Under the new condition of operation, the pressure on Conduit No. 8 is reduced but the velocity of flow is increased. The capacity of Conduit No. 8 and Conduit No. 20, operated in series, is 100 mgd. In future, when Conduit No. 20 is extended upstream all the way to the intake, the capacity will be 200 mgd.

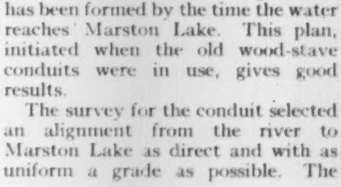
Conduit No. 20 will receive water not only from the direct flow of the South Platte River but also from three upstream storage reservoirs on the river having a combined capacity of 192,959 acre-ft. Denver's present use of water is 32,345 million gal per year. Because of the semi-arid climate, a large percentage of the stored water must be held in reserve.

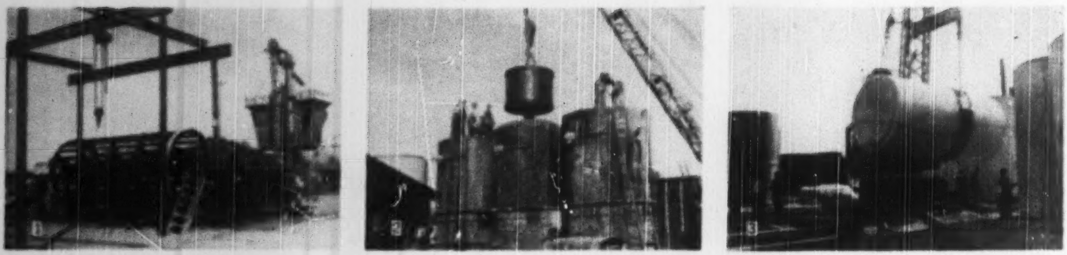
Marston Lake, with a storage capacity of 16,576 acre-ft, serves as a settling reservoir to improve the quality of water supplied to the North and South Side Filter Plants, and also has the capacity to provide reserve water and meet daily fluctuations in supply and demand. Much of the time the river water has a turbidity of only 10 ppm, but for long periods in the spring the turbidity is greatly increased. If the river water has a turbidity of less than 100 ppm the filter plants can function fairly well with water from Marston Lake.

At present the Denver Water Department is crowding all its facilities in order to meet the demands of the rapidly growing city. To get maximum delivery from the filters when the river water has a turbidity of more than 100 ppm, the water at the river intake is treated with alum, making a long mixing basin of the 12 miles of conduit lines. A good floc has been formed by the time the water reaches Marston Lake. This plan, initiated when the old wood-stave conduits were in use, gives good results.

The survey for the conduit selected an alignment from the river to Marston Lake as direct and with as uniform a grade as possible. The

ALUM PLANT on Platte Canyon Reservoir, typical of several such installations, introduces alum into raw water when turbidity passes 100 ppm. Floc settles out in reservoirs, thus lightening load on filter plants.





BAR-TYPE PIPE for recently completed concrete pressure line of 90-in. diameter was cast in central yard in 16-ft sections each weighing 21 tons. For heads above 112 ft, cylinder-type pipe was used, in which welded and hydraulically tested cylinder, reinforced by winding with steel rods, replaces inner reinforcing cage. (1) Steel reinforcing cage for bar-type pipe is formed by winding continuous steel rods on mandrel, then welding circumferential rods to longitudinal bars. Batching and mixing plant is in right background. (2) 4,000-psi concrete is poured into pipe forms. (3) Completed 16-ft pipe section is removed from forms to storage yard, where it is placed on skids.

line follows along the foot of the hogback flanking the front range of the Rocky Mountains but is above the floor of the South Platte River valley. To shorten the line three deep cuts, one tunnel, and three inverted siphons were constructed.

The two old wood-stave pipelines which Conduit No. 20 replaces, followed the floor of the valley for four miles before taking to the hills. Although this alignment increased the head on the pipelines, it would have been followed with the new line except that this area will be within the basin of the Chatfield Flood Control Reservoir being planned by the Corps of Engineers. The Bureau of Reclamation plans to include this reservoir in its Blue River project. For these reasons the new conduit alignment was kept on higher ground and well away from rather steep hill slopes, since there is a possibility of slips in the clay banks when the Chatfield Reservoir is filled.

At the point where the conduit crosses the Deer Creek Valley, complete adherence to these principles would have lengthened the line nearly two miles in order to meander the valley, which will form an arm of the reservoir. Instead it was decided to cross the valley with an inverted siphon. The hazard of this construction did not seem to be great because the Deer Creek Valley is narrow and the siphon crosses it at right angles. However, provision was made for relocating the conduit around the Deer Creek Valley arm of the reservoir if and when the Chatfield Dam is constructed. The pipe was designed to withstand the additional head created when the hydraulic gradient is raised to give the same flow through the line when thus lengthened by two miles. This change would of course also require raising the diversion dam.

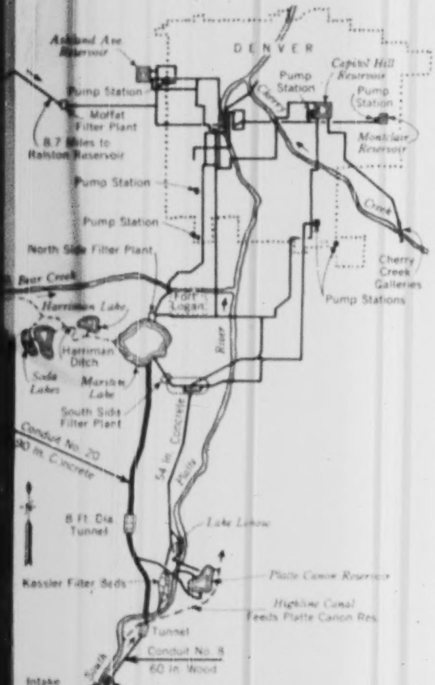

Ashland Ave Reservoir
DENVER
Capitol Hill Reservoir
Pump Station
Pump Station
Pump Station
Moffat Filter Plant
8.7 Miles to Ralston Reservoir
Cherry
Montclair Reservoir
Pump Station
Creek
Pump Station
North Side Filter Plant
Cherry Creek Galleries
Bear Creek
Fort Logan
Pump Stations
Harriman Lake
Harriman Ditch
River
Soda Lakes
Marston Lake
South Side Filter Plant
Conduit No. 20
90 in. Concrete
54 in. Concrete
Platte
8 Ft. Dia. Tunnel
Lake Lenore
Kassler Filter Beds
Platte Canon Reservoir
Highline Canal
Feeds Platte Canon Res.
Tunnel
Conduit No. 8
60 in. Wood
South
Intake 26 Miles to Lake Cheesman
Sand Trap
0
5
Scale in Miles

FIG. 1 **IMPORTANT LINK** in water supply system of Denver, Colo., is Conduit No. 20, concrete pressure line of 90-in. diameter 10 miles long, which was placed in service in March to replace two obsolete wood-stave lines. New $3,500,000 pipeline, together with short section of repaired wood-stave line (Conduit No. 8), connects intake from South Platte River with Marston Lake which serves as settling reservoir to improve quality of water supplied to city's North and South Side Filter Plants.

The conduit was designed as a flow line with regulation at the intake. All high points in the conduit are provided with either a standpipe or a cluster of air valves, and all low points are provided with blow-offs. In case difficulty is experienced in draining the conduit through the blow-offs by gravity, there are blind flanges to permit pumping. Manholes are incorporated to permit inspection of pipeline and tunnel.

A 36-in. pipeline, connecting to Conduit No. 20 near the upper end, delivers water to Platte Canyon Reservoir during the winter months.

Eight bids were received on the pipe required for Conduit No. 20. Seven were for concrete pressure pipe, and one was for reinforced concrete conduit constructed in place with expansion joints, and with steel pipe for inverted siphons where heads were more than 100 ft. The Lock Joint Pipe Co. was the low bidder, and manufactured the pipe in its south Denver plant, of which Frank W. Squires was superintendent. The company subcontracted all field work to Gordon-Bressi & Bevanda, general contractors, whose project manager was Roscoe P. Downs, Assoc. M. ASCE.

The pipe, of 90-in. inside diameter, was made in 16-ft lengths, each length weighing about 21 tons. The job required 3,220 lengths.

The mix contained $7^1/_2$ sacks of cement per cu yd of concrete, and $6^1/_2$ gal of water per sack of cement. Concrete was required to develop a compressive strength of not less than 4,000 psi in 28 days. Sand and gravel for the concrete aggregate were obtained from local pits near the South Platte River.

In general, the method of manufacture followed the tentative specifications of the American Water Works Association for cylinder-type concrete pipe not prestressed.

Curing specifications required three days steam curing and subsequent storage for ten days. Bar-type pipe was used on the major part of the line, which was low head. Four different types of pipe, marked A, B, C and D, were designed for four different heads—48, 75, 100, and 112 ft respectively. For higher heads cylinder-type pipe was used; marked E, F and G, for heads of 125, 150 and 175 ft respectively.

The steel reinforcing cages for the bar-type pipe were formed by winding continuous steel rods on a mandrel. Rods varied in size from $^1/_2$ to $^{23}/_{32}$ in., and the spacing varied from 3.27 to 4.20 in. With this selection of material and spacing, sufficient steel was placed to furnish the required reinforcement to withstand pressures due to hydraulic grade at a tensile stress not exceeding 10,000 psi. For cylinder-type pipe a tensile stress of 12,000 psi was permitted.

The inside cage was welded to the joint rings. Twelve $^1/_2$-in. longitudinal rods were used on both inner and outer cages.

In setting up the pipe forms, the sequence of operations was as follows: The inner form was set on the base plate; the inner reinforcing cage was placed over the inner form; the outer cage was placed over the inner cage; and the outer form was placed. The inner cage was held in place by engaging the bell joint ring in the base plate at the bottom, and by engaging the spigot joint ring in the pouring platform at the top. The outer cage was held in place by inserting temporary spacer rods between it and the outer form. These spacer rods were removed after the concrete was poured. For tamping the concrete, portable vibrators were used, also electric vibrators clamped to the outer form.

In the cylinder-type pipe, a steel cylinder took the place of the inner cage in the bar-type pipe. The first step in making the cylinders was to tack-weld seven longitudinal sheets together. Next the sheets were rolled as a unit and the joint rings were welded to the cylinder. Finally the longitudinal welding was completed with an automatic welder.

Before being wound with reinforcing rods, the cylinders were subjected to a hydraulic test. The testing equipment consisted of a cylinder about $1^1/_2$ in. smaller in diameter than the pipe cylinder. The pipe cylinder was slipped over the test cylinder and held in place by test heads. The space between the test cylinder and the pipe cylinder core was then filled with water and the cylinder tested under pressure. The cage was completed by winding the cylinder with continuous reinforcing rods, as described for the cage of the bar-type pipe.

The plant was designed to produce 16 lengths of pipe a day. Base plates for 48 forms were used but only 16 shells were required. As soon as the shells were pulled, on the day following pouring, the concrete was sprayed with a solution of sodium silicate or water glass.

Conduit Completed in About Fourteen Months

Construction was started December 22, 1948, and completed February 18, 1950. The work, which required the excavation of 403,189 cu yd of earth and 26,159 cu yd of rock, could not be prosecuted continuously from end to end of the conduit. The old conduit, which had to be kept in service as long as possible, followed the site of the new work for 2,000 ft. In other locations work was postponed because of water conditions, or the presence of growing crops.

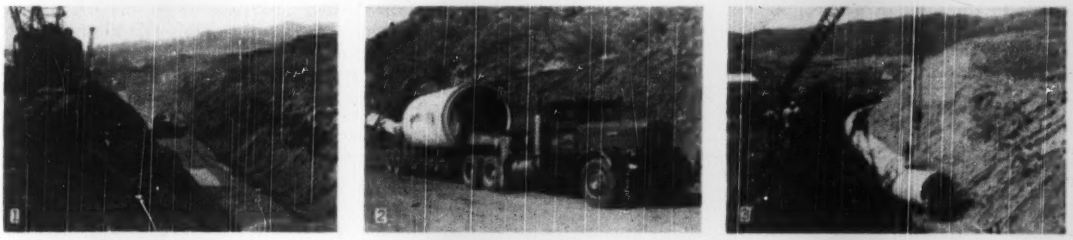
The first step in the trench excavation was the use of carry-scrapers to remove the top soil and pile it separately along the right-of-way. Then the excavation was completed nearly to grade with a $2^1/_2$ and a $3^1/_2$-cu yd dragline machine. Rough grade stakes were set in the trench at integral numbers of feet above the finished grade. Guided by these stakes, a Caterpillar D-4 leveled the trench bottom to within 0.2 or 0.3 ft of the finished grade. Blue-top stakes were set to exact grade and laborers with shovels brought the surface of the trench floor to grade. At some points, where water was encountered in the trench, a Northwest D-80 with a clamshell bucket was used to muck out mud and slush. In these sections graded gravel $^3/_4$ in. to 3 in. in size was used to stabilize the foundation and provide a firm floor before the pipe was laid.

The pipe was hauled from the manufacturing plant to positions along the trench with low-bed, semi-trailer equipment. Saddles were used on the low beds to support the pipe. From three to five outfits were used daily. One 21-ton pipe section made a load. The pipe, which was stored on skids in the yard, was rolled onto the truck by using a bulldozer equipped with rubber-tired truck wheels mounted on the front for bumpers.

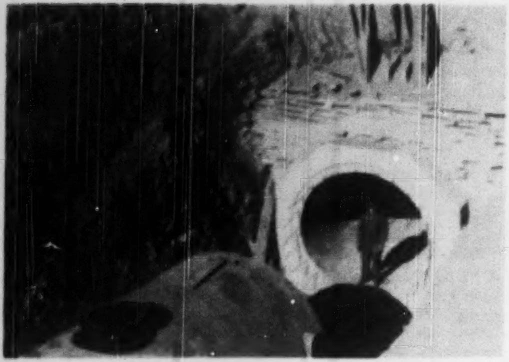
A $3^1/_2$-cu yd Lima dragline was used to place the 16-ft pieces of pipe in the trench. Before the pipe was lifted by the crane it was inspected and cleaned. The bell and spigots were washed with liquid soap and a round rubber gasket was placed on the spigot end. The pipe was then lowered into the trench and the spigot entered into the bell of the pipe already in the trench. Each new length of pipe was pulled into place by a cable hitch attached inside the pipe already laid.

Pipe laying was in progress 136 actual working days. An average of 24 pipe sections were laid a day, and the maximum day's work was 49 lengths. As the pipe was laid, paper shields were placed around the joints and later the opening at the outside of the joint was filled with grout. The joint on the inside of the pipe was packed with a dry-mix mortar.

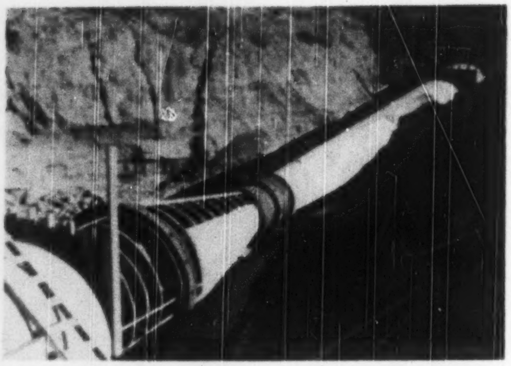
The first foot of backfill was placed under the pipe by hand, after which the trench was filled to 1 ft above the



AFTER REMOVAL of top soil, draglines excavate main prism of pipe trench. (1) Gravel is laid in wet trench to form stable foundation. (2) Low-bed semi-trailer unit delivers 16-ft length of 90-in. pipe weighing 21-tons, to job. (3) Pipe sections for curves were cast with $7^1/_2$-in. bevel on spigot end to facilitate laying.



PORTAL OF 8-ft tunnel, driven by city Water Department's own forces, is ready for insertion of transition section to be placed by general contractor to connect with 90-in. pipe. Manholes are incorporated to permit inspection of pipeline and tunnel.



VENTURI TUBE near upper end of conduit measures flow. Inlet and throat rings, purchased from Builders-Providence, Inc., were built into concrete by contractor. Here, inner forms are being installed for concrete work.

springing line by dragline and this part of the backfill settled by jet puddling. Next the trench was backfilled to the full depth and again jet puddled. Except in deep cuts the trench was then filled to the top, and the top soil replaced on the surfaces.

Before acceptance of the conduit, leakage tests were made. The contractor made the tests, dividing the pipeline into six sections for the purpose. Each section was tested for 24 hours at a pressure equal to the average hydraulic head on that section. The allowable leakage for bar-type was 125 U.S. gal per in. of diameter per mile of pipe, per 24 hours; for cylinder-type pipe the allowable leakage was 60 percent of that allowed for the bar type. All six of the tests showed leakage of less than one-third of that allowable.

A Venturi meter was constructed near the upper end of the conduit. The inlet and throat rings and the registering equipment were purchased from the Builders-Providence, Inc. The rings were placed and built into the concrete tubes by the contractor.

A simple concrete chamber with a flashboard and a fan-shaped apron permits the flow in the conduit to discharge into Marston Lake without threat to the earth dam.

The original call for bids included the 3,005-ft tunnel section as part of the work to be done by the general contractor. According to plan it was to be drilled 10 ft in diameter and then lined with 1 ft of concrete, making the finished diameter 8 ft.

The bid made by the general contractor submitting the lowest bid on the entire job was $639,000 for the complete tunnel. The engineers' estimate was $425,000. The contractor had bid high because of bad conditions recently encountered in driving similar foothill tunnels 75 miles to the north.

After a geological investigation made for the Department, the conclusion was reached that little or no groundwater would be encountered in the tunnel and that practically the entire distance would be through Pierre shale, a rather soft material. It was therefore decided to drive the tunnel with the Water Department's own equipment and personnel rather than to pay the contractor for a hazard which might not exist. This the Department was prepared to do, since both equipment and men were available from other tunneling operations. The tunnel was actually completed in 220 days and for $53,000 less than the engineers' estimate.

All equipment was air-operated with the exception of the locomotive, which used storage batteries. Local power was available for lights. Because of the nature of the shale, short drill holes were used, averaging 4 ft in depth and 30 holes to the round. Eight pounds of 45-percent dynamite were used per linear foot of tunnel. When deeper holes and more powder were used, the overbreak was excessive and had to be filled with concrete during the lining operation.

The invert lining was placed first. This operation started at the upstream end of the tunnel and proceeded down grade to the mixing plant. The concrete was mixed at the portal and hauled into the tunnel in dump cars. Supports for the steel liner forms for the arch were placed in the invert.

The arch was placed with Pumpcrete equipment starting at the center of the tunnel and working toward the portal, it being necessary to move the mixing plant from one portal to the other in order to complete the lining. The maximum pumping distance was 1,585 ft through a 7-in. pipe, a greater distance than is considered good practice in the use of Pumpcrete equipment. However, the difficulties encountered with the long pumping distance were balanced by the advantages gained in placing the concrete at distances of less than 1,000 ft. Considerable difficulty was encountered in the first operation but when the equipment was moved and the second half of the tunnel was lined, only incidental difficulties were encountered.

Cost Data for Tunnel and Pipe

The cost of the project, not including the tunnel, was $3,105,515, and the tunnel cost was $371,828, or a total of $3,477,342. The cost per foot of driving the tunnel to the 10-ft diameter before lining was $53.87, and the cost of lining to give an 8-ft diameter added $69.87 per foot, making the total $123.74 per ft.

The contractor's bid price for the 90-in. bar-type pipe, installed, was $53.50 per ft, and for cylinder type pipe, $60.50 per ft, with extra for rock excavation and the conduit inlet into Marston Lake.

For the Board of Water Commissioners the following served on the project: John Burgess, office engineer; Frank M. Brown, designer; H. R. Oliver, senior engineer; Ray B. Emens, resident engineer on conduit construction; R. G. Akin, resident engineer on tunnel construction; and Merle L. Sowell, superintendent of tunnel construction.

A National Water Policy Needed

Basis for Conservation, Development, and Use of Water Resources Recommended by an Eighty-Engineer Group Sponsored by Engineers Joint Council Water Policy Panel

ENGINEERS for some time have felt serious concern over the fact that billions of dollars of public funds are being spent on water resources projects without full consideration of their economic justification. These funds are authorized by Congress for expenditure by the various federal agencies without that coordination which is essential for over-all national welfare. Feeling that this situation can only be remedied by the adoption of a single over-all national policy for the economic justification of water projects, Engineers Joint Council in 1947 appointed a committee to study and report on the whole subject of the development of the nation's water resources.

Appointment by President Truman of the temporary Water Resources Policy Commission within the past few months (CIVIL ENGINEERING, February 1950, page 72) has again focused the nation's attention on a complex problem. The Panel's recommendations, summarized in these pages, are the result of the independent studies and remarkable agreement on general principles of its nine Task Committees. These recommendations were presented to the President's temporary Water Resources Policy Commission on July 1.

"As of 1948, the whole group of federal water development projects then under construction is said to have involved an expenditure of funds greater than those expended for all projects in all the years preceding June 30, 1947, approximately five billion dollars. At the same time projects not yet under construction, but already proposed by federal agencies, will require twenty billion more to build." These words are from the Coordinating Committee's report to the Water Policy Panel of EJC.

Such large expenditures for water resources development impress the EJC Panel with the need of re-emphasizing the fact that federal funds are not unlimited and that, where various needs compete for money in our national economy, criteria are essential by which to distinguish between "good" and "poor" undertakings. The last two decades have been characterized by a surprising lowering in the quality of the criteria applied to justify water resources developments.

Engineers Joint Council
Water Policy Panel

E. L. Clark, AIME
R. D. Hoak, AIChE
C. W. Mayott, AIEE
W. F. Uhl, ASME
W. W. Horner, ASCE, Chairman

Not all benefits to be derived from national undertakings are easily convertible into quantitative terms, but the lack of pertinent criteria must result in chaotic and indiscriminate expenditures, whereby good and bad projects are jumbled together. The nine Task Committees of EJC are all convinced that measurable quantitative criteria are essential for the common sense evaluation of water resources projects. It is recognized that the national defense is of paramount importance. Where well authenticated, specific needs of national defense must be met and cannot be met from other sources, that fact alone is adequate justification. However, intangible benefits claimed as contributions to "national welfare," "national defense," and "the general good" should not be considered in calculating economic justification. The contributions must be specifically identified and considered entirely apart from those factors which are susceptible of quantitative measurement.

Present Rate of Development Held Excessive

Reporting that "the present rate of planning and Congressionally authorizing water resources developments is excessive and economically unsound," the EJC Panel believes that more time and more data are required to determine whether there is a real need for each proposed development.

The report further states that "conservation and control of the waters of the United States are in the national interest, but are not necessarily a function of the federal government. On the contrary, that which can be done by the individual should be done by him, and that which requires collective action should be done at the lowest governmental level practicable. The federal government should engage in the conservation and control of waters only when the collective action of all of the people of the nation is necessary for accomplishment of the objectives."

"Such collective action through the medium of the federal government," the report continues, "is justified for only two purposes: first, to do those things which are essential to the national defense or otherwise are of substantial benefit to all of the people throughout the nation; and second, to aid in the financing of the cost of construction of works for the benefit of a limited number of people on terms equitable to all other citizens of the nation."

Federal water projects should be self-liquidating and self-supporting. Beneficiaries of these developments should be required to repay the government for direct benefits, and all government subsidies recommended should be disclosed in full detail in requests for Congressional authorization and in every subsequent report. Computations for the economic justification of federal projects should include amounts equal to taxes and should anticipate actual payment of property taxes as though the property were privately owned. "This principle," the Panel recommends in cases of federal revenue-producing developments, "should be extended to provide for the payment of federal and state income and excise taxes." A project, to be economically justified, must show without exception a ratio of tangible benefits to cost of not less than 4 to 3.

The amount of the Congressional authorization should serve as the absolute limit on an appropriation for an individual project, and any substantial change in the project should be reviewed by Congress. The Panel believes that an authorization from Congress should become void if a project overruns by as much as 20 percent the cost estimated at the time of authorization, and that such a project should be subjected to review and recommendation to Congress by the appropriate legislative committee.

Board of Impartial Analysis Needed

The Panel recommends finally the creation of "a board of impartial analysis and appraisal of federal water projects" whose review and favorable report would be a prerequisite for Congressional authorization or appropriation. "It is almost impossible," concludes the Panel, "for individual agencies, restricted by Congressional Acts and under the impact of many pressure forces, to view projects objectively. Agencies which are under the necessity of competitive survival, with high principles but with equally high desires to develop in size and significance, cannot be expected to appraise the validity of undertakings in the most abstract and impartial manner."

There should be instituted on the federal level a statutory body whose function it would be to review each proposed water resources development to determine its wisdom, its economic feasibility and its priority in relation to all other such developments, the report states. This body should have no part in the initiation, design, or construction of projects.

◆

Domestic and industrial water supply, although nationwide in extent, present essentially local community problems, declares Task Committee No. 1 in its report to the Coordinating Committee. "Of the 13,000 public water systems serving 85 million people with about 15,000 mgd of water, nearly all are intrastate. Without adequate supply, properly safeguarded against pollution, urban life cannot exist. Accordingly these water supplies should be built and paid for by those using the service."

Contrary to public belief, there is no basis in experience for the fear that surface and underground water resources are declining, the committee reported. Shortage of water is neither universal nor increasing. Intelligent husbanding and allocation are the keys to the future.

◆

Pollution of domestic and industrial water should be regulated at the lowest governmental level adequate to handle the particular situation. Federal jurisdiction and participation should be limited to administration of existing laws and to research and guidance upon which sound and uniform local laws may be based.

◆

Flood control should not be the sole concern of the federal government, reports Task Committee No. 2. Flood control should be effected by cooperative efforts between federal and local interests. All such projects should be subject to review and approval for economic feasibility by a competent board, and the cost should be borne proportionally by those benefited, including the federal interest. Loaning of money to local interests by the federal government from a revolving fund with provision for repayment over the estimated life of the project, but not for a period exceeding 50 years, is a practice approved by the task committee, but the committee sees no justification for "incentive payments" to land owners who undertake soil conservation work to retard erosion by wind and rain. It is highly important, the committee feels, to apply soil conservation practices before small detention reservoirs are built.

Coordinating Committee for EJC Task Committees

B. A. Bakhmeteff, M. ASCE
L. H. Enslow, M. ASCE
Julian Hinds, M. ASCE
M. M. Leighton
E. L. Moreland, M. ASCE
Thorndike Saville, M. ASCE
Abel Wolman, M. ASCE, Chairman

◆

Inland waterways in the United States have a total length of 28,591 miles and include 480 locks and dams and 270 harbors, states Task Committee No. 3. Total federal expenditures for river and harbor navigation projects to June 30, 1949, it reports, approximate $3.7 billion, requiring in 1949 a maintenance cost of $83.5 million. The addition of new projects is creating an ever-growing annual charge for maintenance and operation.

In 1948 the Chief of Engineers estimated that nearly four billion dollars would be required to complete the construction of already authorized and recommended river and harbor work, and the Army Engineers are investigating 1,053 additional projects.

Task Committee No. 3 notes that a number of inland waterway projects are devoid of justification and recommends that an effective procedure be set up for the termination of uneconomical projects. It advises against government subsidies for construction; and against construction of any toll-free canal or other type of navigational improvement. The use of inland waterways as a regulatory agency to force reduction of land carrier rates is condemned.

◆

"Irrigated land in the United States aggregates 22 million acres," reports Task Committee No. 4. "Irrigation projects under construction and being considered involve another 13 million acres of reclamation, and 8 million acres of supplemental irrigation." More land is suitable for irrigation than the available water resources can serve. The most economical projects have already been built, the committee said, and further developments will be costly and too large for private groups to undertake.

Irrigation projects should be self-liquidating; the progressive trend toward shifting the entire burden onto those "who bear the expense of government through taxation" should be stopped. The long-accepted national policy of subsidizing irrigation development, and the step-by-step extension of the time for repaying construction costs without interest to the 50-year period now in effect, when taken together constitute a total and partly hidden subsidy far greater in amount than is commonly realized. "As a matter of national policy," the committee concludes, "it would be far better to evaluate realistically the ability of water users to pay annual charges; to use annual payments by them to amortize a part of the capital invested in irrigation works with interest at the average rate paid by the government on the national debt; and to define clearly the balance of the construction cost to be amortized from power revenues and other sources within the useful life of the works constructed."

◆

Drainage of 20 million acres of wet, swampy and overflow land in the United States could be accomplished at reasonable cost, states the report of Task Committee No. 8.

Of this acreage, 6.4 million acres are wholly or in part cultivated, and 13.6 million are undeveloped. Another 29 million acres in organized districts need improved drainage.

Federal contribution to a drainage project should never exceed one-half of its cost and in no case should the cost per acre exceed the value of productive land similarly situated. However, lands awaiting reclamation through drainage and irrigation are not deteriorating and the committee believes they should be regarded as a useful reserve for future needs. The present trend toward higher productivity of land can be expected to supply food and fiber for our growing population without increasing the acreage of crop land. From 1920 to 1945 the population increased one third, yet the area of crop land remained practically stationary. To increase agricultural production in the face of existing surpluses constitutes an economic liability.

There is an opinion that worn out and eroded lands and other lands of low fertility can be put into satisfactory production at a capital investment of under $50 per acre; that wet lands can be cleared, drained and made ready for cultivation at from $50 to $100 per acre; but that the cost of supplying water to dry lands by means of irrigation will be in the order of $200 to $500 per acre on the better remaining possible projects. Irrigation projects are now under consideration where the cost may exceed $1,000 per acre, the report states.

The committee believes that a study should be made "to determine, when and if there is need for placing new lands under cultivation, the relative advantage in terms of national interest, of developing the land through various means." "Demonstrated need should be the first step in the determination of economic justification for putting more crop land in production," this committee concludes.

◆

Federal power development should be surrounded by certain limitations, reports Task Committee No. 5. "There should be no subsidization in respect to capital costs; nor by way of the sale of power at less than its true cost." In calculating costs, amounts equivalent to taxes on land, improvements and business should be included. Local enterprise in general should have priority to build hydro developments under governmental regulation and control. The sale of federal power should generally take place at generating stations and at rates that will secure as cash income to the federal treasury the full value of the power as appraised at the time the project appropriation was made.

Transmission lines for electric power built by the government should be limited to the absolutely essential needs of the government, which of course include specific needs for national defense. However, a mere general claim of a contribution to national defense or of the strengthening of national economy should not constitute adequate justification for, or even be considered as a part of the tangible benefits required for, economic justification for the federal development of power.

The report of this committee concludes with the statement that "federal hydroelectric projects cannot be reasonably used as measures of economic efficiency, or of propriety of costs or rates for privately produced power."

◆

"Public recreation means something more than amusement," states Task Committee No. 6. "It involves constructive use of the leisure time which is becoming increasingly available to most people." Recreation, like education, provides such intangible benefits that they are not susceptible to evaluation in terms of money. The government supports recreation in a number of ways, but before funds are authorized for recreation at multiple-purpose projects, Congress should adopt a National Recreation Policy. With the fixing of the total expenditures which the United States should reasonably devote to recreation, all recreation projects, including those of multi-purpose water projects, would be compared on the basis of national interest.

Methods of appraisal of benefits from recreation, fish and wildlife facilities now in use by various agencies of government are unrealistic and arbitrary. This committee strongly recommends that no monetary benefit be assigned to these facilities in the calculation for economic justification of a federal water project except only such sums as are collectible in income in the form of rentals and leases, admission fees, and sale of land, or such contributions as will be made by state or local interests for this aspect of the project.

Task Committees of EJC Water Policy Panel and Chairmen, all Members, ASCE

No. 1. **Domestic and Industrial Water Supply and Pollution, L. R. Howson**
No. 2. **Flood Control, including Water Flow Retardation, J. C. Stevens**
No. 3. **Navigation and Inland Water Transportation, Carey H. Brown**
No. 4. **Irrigation, S. T. Harding**
No. 5. **Hydroelectric Power, F. W. Scheidenhelm**
No. 6. **Recreation, Fish and Wild Life, M. P. O'Brien**
No. 7. **Basic Water Resources Information, G. R. Williams**
No. 8. **Land Drainage, L. L. Hidinger**
No. 9. **Policies of General Applicability, D. L. Erickson**

◆

Basic water resources information should continue to be collected by federal-state cooperation, Task Committee No. 7 states. Fact-finding federal agencies, now understaffed for the purpose, should be provided with additional funds and personnel to enable them to process and analyze the collected data, and to provide for prompt publication.

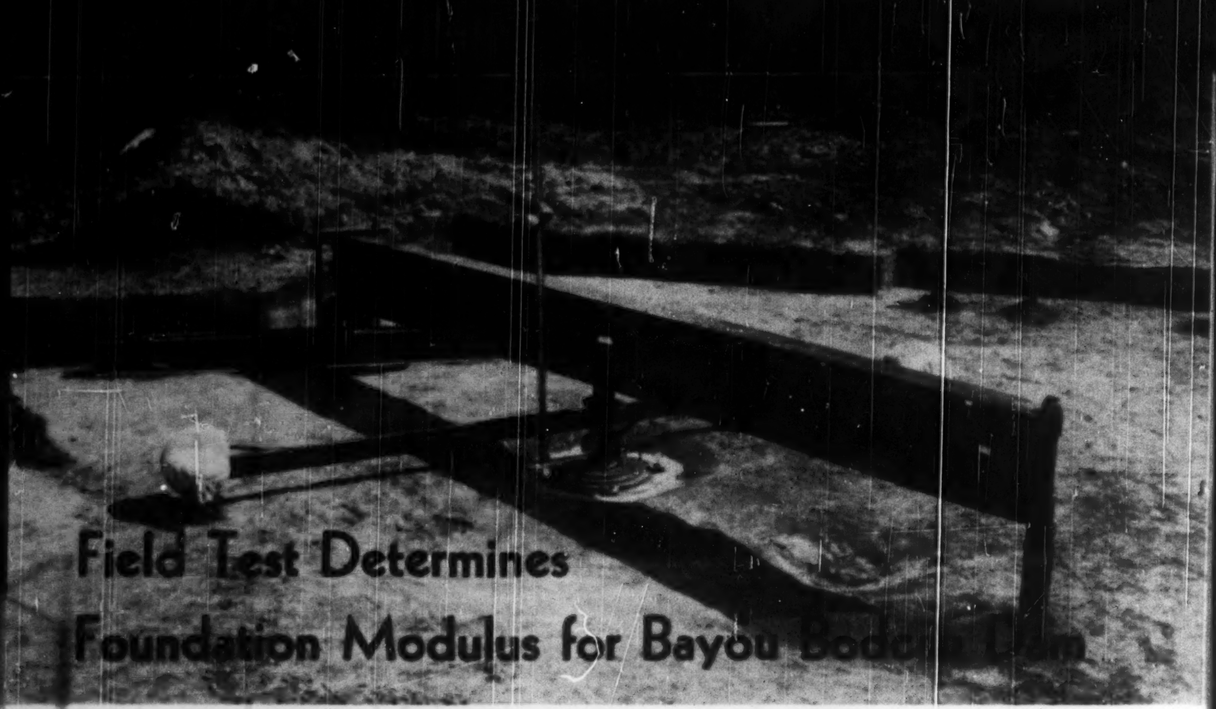
◆

Engineers Joint Council is an organization of the following five national engineering societies:

- American Society of Civil Engineers
- American Institute of Mining and Metallurgical Engineers
- The American Society of Mechanical Engineers
- American Institute of Electrical Engineers
- American Institute of Chemical Engineers

It is a clearing house for these five societies on matters of common interest. It has many fields of action, among them that of coordinating the services which members of the engineering profession render to the public. The work of EJC's National Water Policy Panel here reported was initiated in August 1947.

(The complete statement of desirable policy by the Engineers Joint Council Water Policy Panel is available for $1.50 from the Secretary of EJC, 29 West 39th Street, New York 18, N.Y.)



Field Test Determines Foundation Modulus for Bayou Bodcau Dam

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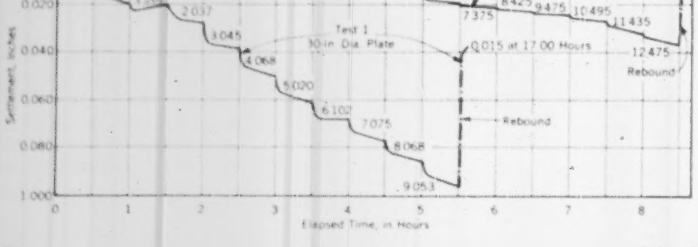
TO DETERMINE the foundation modulus of soils in the stilling basin at Bayou Bodcau Dam on Bayou Bodcau in northwestern Louisiana, the Mississippi River Commission, Corps of Engineers, requested the Waterways Experiment Station to conduct the necessary tests at such time as the excavation for the structure reached approximate grade. The foundation modulus was wanted for the purpose of checking the structure as originally designed. The investigational program consisted of field bearing tests and laboratory triaxial shear tests on the foundation soils.

In the stilling basin at Bayou Bodcau Dam, where the tests here described were conducted in the summer of 1948, the soils below grade consisted of soft clay shale and some clay to an explored depth of about 10 ft. The clay shale had a water content of about 35 percent and a natural dry density of about 87 lb per cu ft. The liquid limits of the material ranged from 81 to 91 and the plasticity index from 46 to 52. Undisturbed samples showed the soil to be somewhat brittle, with the presence of some relatively horizontal laminations.

Two plate bearing tests were performed on the surface of the foundation soils in an area of the outlet-works stilling basin that had been excavated to grade. Test No. 1 was made with a 30-in.-dia rigid steel plate. Test No. 2 was made with a 13.54-in.-dia plate having a contact area of 1 sq ft. Identical methods of site preparation and test procedure were used in both tests, with the exception of the load increments applied. The accompanying photographs show the general setup. The plate, with hydraulic jack on top, rests against a large beam which is held in place by anchors screwed into the ground. A supplementary smaller beam supports two dial gages which measure the deflection of the plate. The reaction points on the supplementary beam are at some dis-

FIG. 1. TIME-SETTLEMENT curves for two plate bearing tests in stilling basin of Bayou Bodcau Dam reflect large initial movement of plate when load increment was first applied, followed by rather slow increase in deflection with increasing time. Deflections were measured at 1-min intervals throughout loading period and during early stages of rebound period. Figures give loads in pounds per square inch.



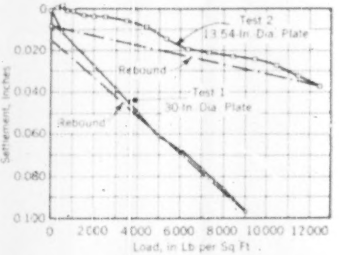


FIG. 2. ELASTIC BEHAVIOR of soil is indicated by approximately straight load settlement curves, above, for two plate bearing tests at Bayou Bodcau Dam. Curves approximate straight line, allowing for inconsistencies in seating and other possible test errors. Rebound almost to initial state also indicates elastic behavior. Greater settlement for test No. 1 reflects influence of larger loaded area. Curves were drawn by plotting final deflection under each load increment against unit load.

tance from the plate so they will not be influenced by ground movement around the plate.

Test sites were prepared by removing the top 2 in. of surface soil, then covering the area with a $^{1}/_{4}$-in. blanket of clean sand to aid in distributing the load uniformly. Light seating loads were applied to the bearing plates before the test-load increments. Cumulative load increments were applied at 30-min intervals and were held constant between successive loadings. In test No. 1 (see Fig. 1 and photographs), made with the 30-in.-dia plate, load increments of about 500 lb per sq ft were used up to a load of 2,000 lb per sq ft, and increments of about 1,000 lb per sq ft were used beyond that to the end of the test. In test No. 2, with the 13.54-in.-dia plate (see Fig. 1), approximate load increments of 250, 500, and 1,000 lb per sq ft were used, the increments increasing with increasing load. At the end of the loading period the load was removed and the plates allowed to rebound overnight. The very rapid rebound of the soil when unloaded indicates that this soil behaved as an essentially elastic body.

In the load-settlement curves, Fig. 2, the most apparent factor is that the settlement was considerably greater for the 30-in.-dia plate, showing that, for this soil at least, settlement is dependent not only on load but also on size of area loaded.

Foundation modulus is defined as the ratio of unit load to settlement. Usually the unit load is determined for some given settlement, such as 0.1 or 0.5 in., and the foundation modulus is determined for that point. In these tests, since practically a straight-line relationship holds between load and settlement, the foundation modulus is constant over the range of loads used. On this basis the foundation modulus for test No. 1 was found to be 695 psi per in. and for test No. 2, 2,200 psi per in. The foundation modulus differs appreciably for the two sizes of plates, which is to be expected.

Using the equation for settlement of a surface load due to elastic deflection and rearranging the terms slightly, the foundation modulus, K, may be expressed as

$$K = \frac{\text{Unit Load}}{\text{Settlement}} = \frac{E}{C_s(1 - \mu^2)b}$$

in which E is modulus of elasticity of soil; C_s, a shape factor; μ Poisson's ratio; and b, diameter or width of loaded area. Using a shape factor of 0.785 for a rigid circular plate and taking Poisson's ratio as 0.5, the modulus of elasticity, E, was calculated for each test as follows:

Test No.	Plate Dia. Inches	K, psi per in.	E, psi
1	30	695	12,300
2	13.54	2,200	17,600

The variation in the two values for modulus of elasticity is small compared to the variation in foundation modulus, which is greatly influenced by the size and rigidity of the loaded area. Differences in modulus of elasticity may be attributed to slight variations in soil type and the influence of other factors in the test procedure.

Foundation modulus can also be determined by laboratory tests on soils for which the modulus of elasticity is evaluated. If the size, shape, and rigidity of the loaded area are known, then the foundation modulus, K, can be computed for the field condition. Foundation modulus is usually calculated from field bearing tests, since values determined from laboratory tests are not particularly accurate. The modulus of elasticity determined from laboratory tests is commonly considered lower than that determined from field tests.

In this investigation, laboratory shear tests were run on undisturbed samples from the site and the modulus of elasticity determined from the stress-strain curves as a check on the field results. Three types of strength tests were run: Unconfined compression; unconsolidated quick triaxial shear; and quick triaxial shear tests on samples which were consolidated but not saturated. (See Fig. 3 for typical curves.)

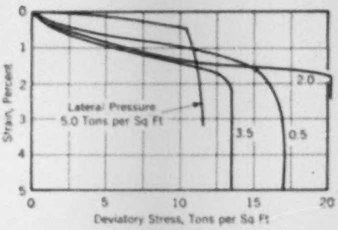


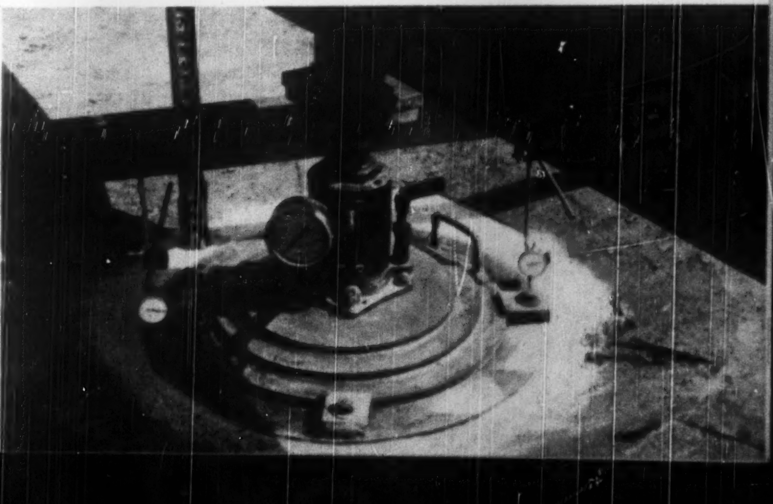
FIG. 3. LABORATORY shear tests on undisturbed samples check field results. Typical stress-strain curves for quick triaxial tests, with samples consolidated but not saturated, are similar to curves secured from other laboratory shear tests.

Modulus of elasticity was determined from the slope of an average straight line drawn through the initial portion of the curves. Laboratory and field values for modulus of elasticity are:

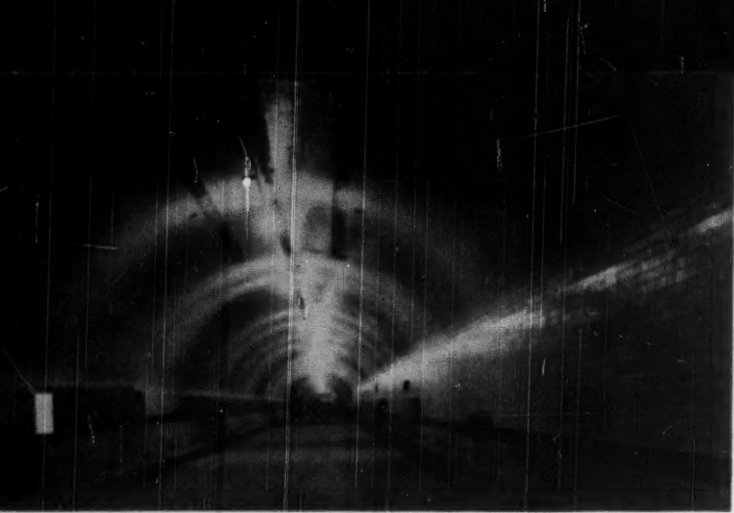
Laboratory Tests	Modulus of Elasticity, psi
Unconfined compression	7,720
Quick triaxial, average of all lateral pressures	9,260
Quick triaxial, consolidated but not saturated, with lateral loads of	
0.5 and 2.0 tons per sq ft	14,600
3.5 tons per sq ft	10,300
5.0 tons per sq ft	39,700
Field Tests	
Test No. 1, 30-in.-dia plate	12,300
Test No. 2, 13.54-in.-dia plate	17,600

It will be noted that the value determined from the unconfined compression test is low, possibly owing to the lack of confining pressure and, in addition, to the presence of horizontal cracks in the sample. The value shown for the triaxial test at 5 tons per sq ft lateral load appears to be high; however, this test condition would correspond to a structure load in excess of that actually used and there-

(*Continued on page 73*)



STACK OF successively smaller plates ensures practical rigidity of bearing plate of 30-in. diameter used for soil bearing test No. 1. Tests in stilling basin of Bayou Bodcau Dam were used to obtain foundation modulus for checking with design values. Hydraulic jack has pressure gage to measure applied load. Above jack are spacer plates and universal joint, bearing against reaction beam, to prevent eccentric application of load. Two dial gages placed diametrically opposite on bottom plate are attached to supplementary beam.



WASHBURN TUNNEL, shown here in nearly completed state, is lined with vitreous, glazed tile set in mortar. About half of 3,000-ft covered length is under water. Tunnel provides two lanes for vehicular traffic plus walkways, air duct and power and telephone lines.

Washburn Tunnel Opened Under Houston Ship Channel

VEHICULAR TRAFFIC between the cities of Houston and Galveston, Tex., will be expedited by completion of the two-way Washburn Tunnel under the Houston Ship Channel at Pasadena, Tex., which was dedicated on May 27. Prefabricated in sections and floated 400 miles to the construction site (see March 1949 issue of CIVIL ENGINEERING, page 39), the 3,800-ft trench-type structure is one of only eight tunnels of the kind in the world.

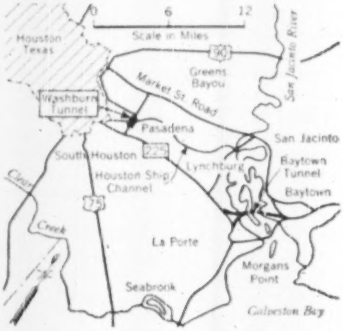
Tunnel Sections Towed 400 Miles

The Washburn Tunnel—named after Harris County Auditor Harry L. Washburn—consists of 855 ft of open ramps; 1,436 ft of concrete arch, built in the dry in open trenches at each end; and a steel and concrete tube sunk in a trench dredged in the channel bed. The latter section is made up of four all-welded steel tunnel sections, each 375 ft long and 35 ft wide across the octagonal-shaped outer shell, and two 12-ft transition sections of the same width. After fabrication at the Ingalls Shipyards at Pascagoula, Miss., the sections were assembled on standard shipways and then launched and towed to an outfitting basin. There special shoring and other reinforcing for launching were removed, and about 900 tons of ballast concrete was poured inside the form plates of each section in preparation for the 400-mile journey through the Gulf of Mexico and the Inland Waterway.

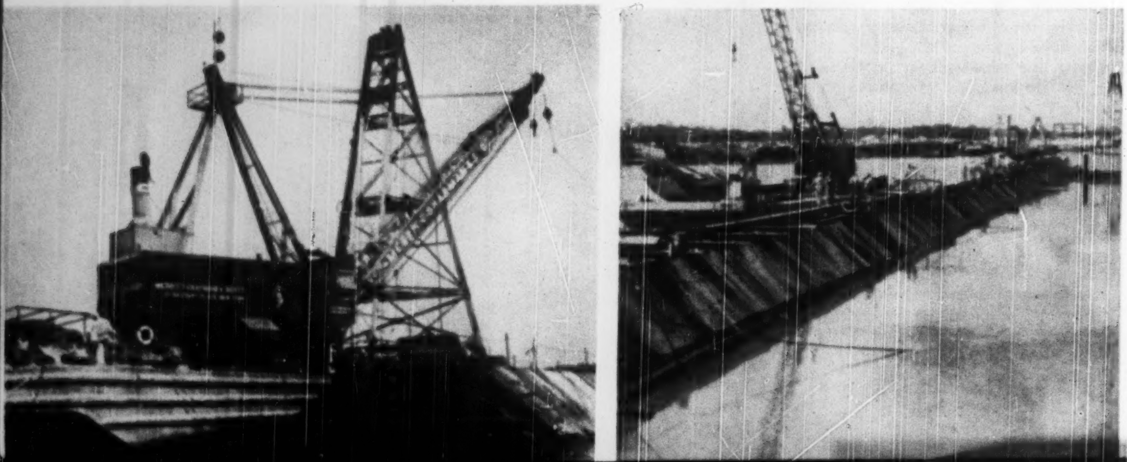
Sections Fitted Out Before Sinking

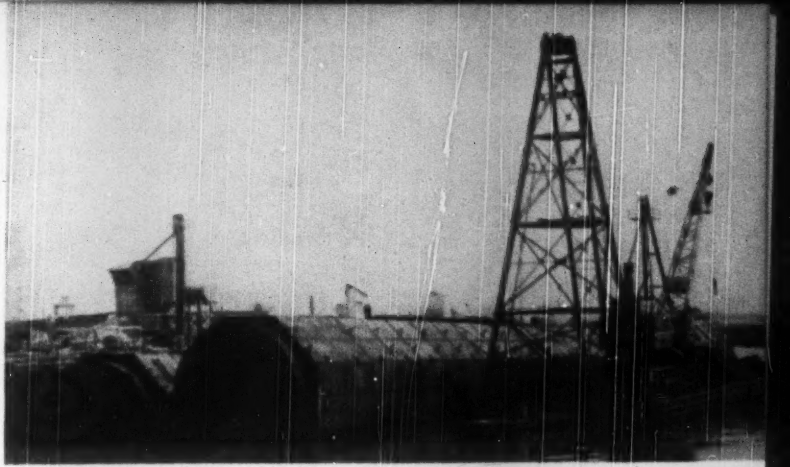
The sections were then towed to the Clinton Docks at Galena Park, two miles from the construction site at Pasadena, for shape-up work. Still afloat, but settling deeper as work progressed, they were fitted with a 2-ft-thick inner ring of concrete, steel-reinforced concrete roadway and walkway, ventilator ducts and conduits.

All the concrete had to be poured through temporary openings in the top of the tube section, which were later sealed by welded plates. In the last pour at the docks, concrete was tremied into the open space between the inner tube and outer shell until each section rode as low in the water as it could without sinking. Every pour had to be delicately timed and



PROPER ALIGNMENT of each tunnel section above its final position in trench on channel bottom is exacting job. With shape-up work completed (below, left and right), sections are towed to positions directly above trench. Sighting with transits on shore, engineers give signals to derrick crews, who inch big floating sections into place. Map at right shows location of tunnel in relation to Baytown Tunnel under Houston Ship Channel, now under construction. (See article by S. A. Thoresen, CIVIL ENGINEERING for January 1950.)





ON ARRIVAL NEAR tunnel site (upper photo), sections are taken to shape-up docks for preliminary interior concrete work. With progress of work, sections sink deeper in water, position of section at left indicating completion of much of initial interior work.

balanced to guard against bending the steel framework or capsizing.

Floated to the tunnel site, the sections were moved into exact position over a 40-ft-wide trench, which had been excavated some 90 ft below water level across the bottom of the channel, and sunk to proper line and grade by additional pouring of tremie concrete between the shells. Masts projecting above the water guided sinking operations.

After sinking to the bottom of the trench, the sections were connected to each other by divers, the remaining concrete was tremied into place between the shells, and the trench backfilled to original grade. The backfill extends about 5 ft above the tunnel top, and the water depth from backfill level to the surface is 45 ft at normal tide. The bottom of the tunnel structure rests approximately 85 ft below the surface of the channel.

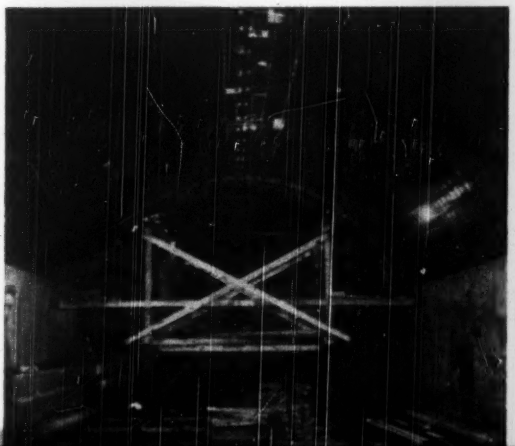
Use of Cofferdams Avoided

Before removal of the bulkheads, the sections were pulled together by ratchets and joined by pilot pins and links, which seated steel sealing rings on one section against a gasket enclosed in a circular recess in the adjoining section to ensure watertightness of the joints. After the tunnel sections had been joined, the final tremie concrete placed, and the backfill completed, the bulkhead sections were removed in sequence, starting at the south end. Following removal of the bulkheads, the joints between each two connecting tubes were then covered with steel channels welded on the inside of the tubes at the point of jointure. By joining the north and south end sections to transition sections, an innovation in the trench method of tunnel construction, elimination of the use of cofferdams on the work was possible. On approaches, 6 percent is the maximum grade.

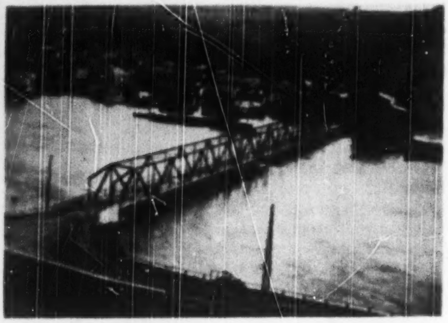
The tunnel was then ready for tile lining, paving of the two-lane reinforced concrete roadway, and for making connections to the four-story ventilation building, which is located at the south end of the tunnel. In addition, some 40 ft of tunnel in 10-ft strips next to the bulkhead sections required complete finishing, including placing of the concrete lining and roadway construction.

Built for the Harris County Commissioners at an approximate cost of $7,500,000, the Washburn Tunnel illustrates the economy of the trench-tremie method of tunnel construction. Total construction time was two years. Palmer & Baker Inc., of Mobile, Ala., was the engineering firm on the project, and the general construction contract was held by the Merritt-Chapman & Scott Corp., of New York.

TUNNEL IS TILED (lower left) after sections are sunk and locked into position on river bottom. Lower right-hand view shows opening of bulkhead into tube No. 1. Bulkhead and bracing are being removed. In air view of tunnel during final stages of construction, at right, snake-like pattern on surface of channel is made by equipment used in placing hydraulic backfill over tube at bottom of channel. Ventilation building can be seen in foreground. Operation of automatic ventilating system is regulated by electronic count of cars.



CLEAN, SIMPLE LINES of 412-ft prestressed concrete bridge (left) built in less than nine months over Meuse River at Sclayn, Belgium, contrast favorably with old two-span steel bridge (below) destroyed during World War II. Original river pier and abutments were used for new bridge as they were in good condition. Prestressed span is continuous beam of two spans, longest bridge of its type that has ever been built.



Longest Continuous Prestressed Girders Carry Sclayn Bridge Traffic Over Meuse River

G. MAGNEL, M. ASCE

Professor, University of Ghent, Ghent, Belgi

BEFORE WORLD WAR II, the river Meuse was crossed at Sclayn by a two-span steel bridge, each span of 206-ft length. As may be seen in an accompanying photograph, this structure left much to be desired from the point of view of appearance. Blown up during the war, it was replaced last year by a continuous two-span deck of prestressed concrete 412 ft in total length. (See article by E. R. Schofield, CIVIL ENGINEERING for September 1949.)

One of the requirements of the design was the retention not only of the central river pier but also of the existing abutments, as these structures had been only slightly damaged when the old steel bridge was destroyed.

Competitive bids were submitted for this contract to the Belgian Ministry of Public Works, which decided to accept the prestressed design, the only one in which the whole structure was kept under the roadway. The solutions presented for both steel and reinforced concrete were of the bowstring type and did not compete with the accepted design from the point of view of esthetics. The cost of a steel bridge was 25 percent higher than that for prestressed concrete.

As the contractor used the existing central river pier and abutments as supports for the new bridge, there was no problem of foundations and no under-water work to be done. The foundation soil was a compact gravel; so that it was safe to use a statically indeterminate superstructure, for instance, the continuous beam with two spans of the chosen design.

This structure, the first large continuous bridge ever built of prestressed concrete, was constructed by the contracting firm of Blaton-Aubert of Brussels in less than nine months. This is also the first time that cables as long as 412 ft have been prestressed. From the point of view of construction no special problems were encountered.

The writer was opposed to building a continuous structure of prestressed concrete until he was satisfied that a sound design method had been developed and that adequate tests had been made to check the agreement between theory and practice. The difficulty in designing a continuous prestressed structure lies in the fact that the prestressing creates external reactions and bending moments. This is not the case in statically determinate structures. These external bending moments have been called secondary moments. The cable suitable for prestressing a continuous beam can only be designed (in size and shape) when the value of the secondary moments is known; on the other hand these moments are a function of the size and shape of the cable. A practical solution to this problem is presented in the writer's book, *Prestressed Concrete*.

The shape and variation in depth along one of the spans is shown in Fig. 1, and a cross section in Fig. 2.

The hollow box girder is provided with five transverse stiffeners and closed at each end by what is generally called an end block through which the cables are threaded. These cables, placed inside the box girder, are 36 in number, each containing 48 wires of 7-mm (0.276-in.) diameter.

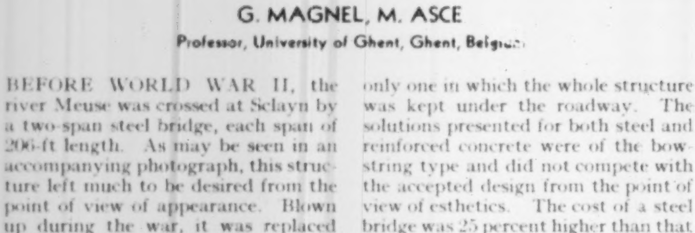
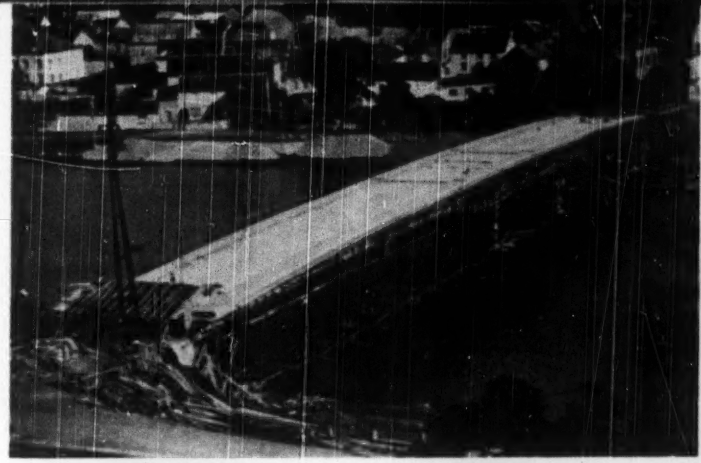

e = Thickness of Variable Lower Face
Center Line
1.97'
1.59'
Full End Block
Stiffener
Stiffener
Stiffener
Axis of Cable
Data Plane
10.59'
0 1 2 3 4 5 6 7 8 9 10
c = 6.20 6.88 7.41 7.84 8.17 8.30 8.26 7.97 7.12 4.53 0 Ft
d = 10.82 11.74 12.66 13.58 14.23 14.66 14.82 15.02 15.22 15.41 15.58 Ft
h = 4.62 4.85 5.25 5.74 6.07 6.36 6.56 7.05 8.10 10.89 15.58 Ft
e = 0.79 0.52 0.42 0.39 0.39 0.49 0.65 0.75 1.54 3.60 Ft
205.72'

FIG. 1 LONGITUDINAL CROSS SECTION shows shape and variation in depth along one span of Sclayn Bridge. Note that depth of structure at midspan is only about 6 ft, or about one thirty-fifth of 206-ft span, and that depth above central pier is about 16 ft.



FORMWORK FOR SCLAYN BRIDGE rests on timber piles driven in river bed down to compact gravel. On piles was placed scaffolding composed of standard steel tubes, with screw jacks at base so that scaffolding could be lowered after concrete had set. Scaffolding supported usual wooden forms.

The cable is composed of two straight parts, one in each span, which means that a slight change in direction occurs above the central pier; thus it may be said that the axis of the cables at the central pier is 0.88 m, or about 34 in., higher than the ends of the cables at the abutments.

The total prestressing force was initially 12,600,000 lb, but it has been admitted in the design that this will ultimately drop to 85 percent of its initial value owing to shrinkage and creep of the concrete and relaxation of the steel.

The loads specified for the bridge were as follows: A uniform distributed load of 400 kg per sq m (84 lb per sq ft) and in addition on each lane the action of a truck of 32 metric tons (32.736 short tons) having four axles, one of 12, two of 6 and two of 4 metric tons, with a distance between adjacent axles of 4 m (about 13 ft). The working stresses specified were:

For concrete, 150 kg per cm^2(2,160 psi)
For steel, 8,500 kg per cm^2(121,000 psi)

Actually the limitation of the concrete stress has only been enforced as far as the main parts of the box girder are concerned; it has been accepted that the stresses in the extreme top fibers of the sidewalks may be 10 percent higher than those given above.

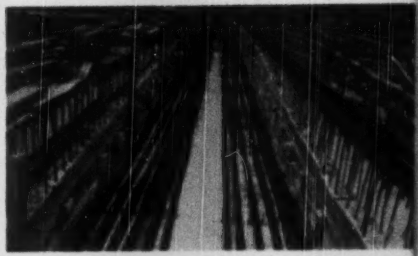
It may be interesting to note that the secondary moment found above the central pier was 9,270 tm (67,138,000 ft-lb) which should be compared with the moment at the same point due to the dead load, equal to 13,630 tm (100,000,000 ft-lb). This comparison shows the great importance of the secondary moments, which cannot be neglected in this design.

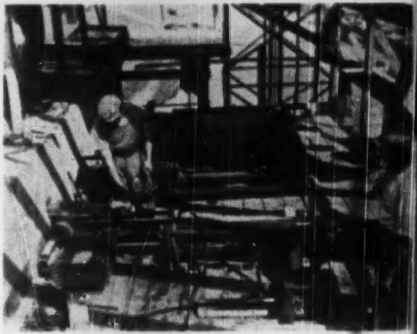
The bottom slab and the lower half of the longitudinal walls of the box girder were concreted first. Then the cables were placed and the concrete work completed. One week later the prestressing work started and continued for three weeks. Four jacks were used, and for stretching each pair of wires one jack was placed at each end of the bridge. The elongation given to the wires equaled 56 cm (22 in.). The total cost of the prestressing labor was less than 1 per cent of the cost of the bridge.

When the bridge was tested under a uniform load of 84 psf on one span, the deflection in the middle of that span was 38 mm (1$^1/_2$ in.).

In all, 1,170 cu yd of concrete were used in the bridge, and 66 tons of steel wire or a total length of 220 km (about 137 miles). The concrete aggregate used was Rhine gravel and Rhine sand, mixed in the proportion determined by the sieve analysis. The concrete contained 400 kg per m^3 of cement or about 673.3 lb per cu yd.

To secure more information on the effect of such factors as creep, shrinkage, relaxation, and temperature, the Ministry of Public Works has decided to take measurements on the bridge over a long period of time. For this purpose, two extra cables of 16 wires each were placed in the box girder and were not protected against rust by cement mortar as were the other





IN ERECTION SEQUENCE, lower slab and half height of longitudinal walls of box girder were concreted first. Then cables were placed. See view at top, right, for appearance of work at this stage. Note that groups of wires are supported at intervals by separators, one for each group, with a separate hole for each 0.276-in. wire. Next step was completion of concrete work, after which wires were prestressed, being threaded through end block at each abutment and held by wedges. Each pair of wires was prestressed by one jack at each end of bridge (see view immediately above).

cables. Measurements of the stress in these free wires can be taken at any time either by measuring the frequency of vibration between two fixed points, or by measuring the deflection between two fixed points caused by a small transverse force. There is no doubt that such measurements taken over periods of months and years will yield information of great value to structural engineers.

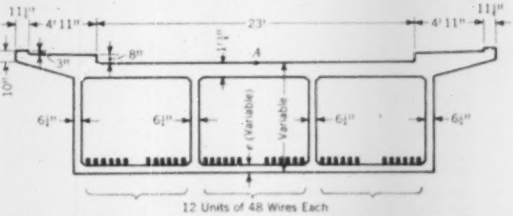
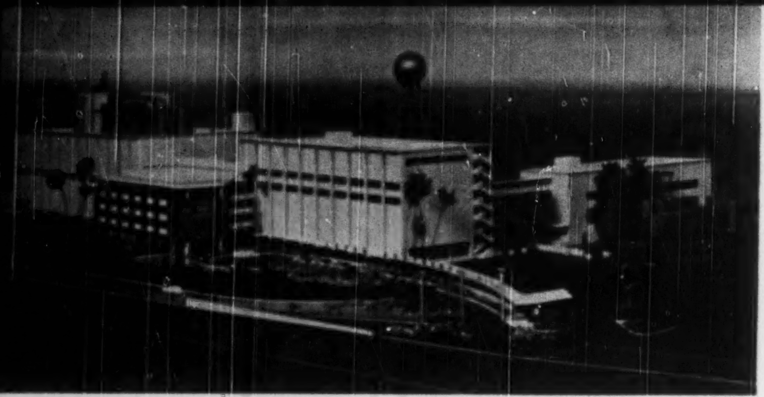


FIG. 2. **HOLLOW REINFORCED CONCRETE** box girder, here seen in typical cross section, has five transverse stiffeners and is closed at each end by "end block" through which cables pass. Cables are 36 in number, each composed of 48 wires of 0.276-in. diameter.



FOUR-STORY ADMINISTRATION building is flanked on right (west) by six-story edible products finishing building and on left (east) by five-story soap finishing building, as shown in scale model of Lever Brothers Company's Los Angeles plant. Office building has flat-slab concrete frame with lightweight concrete used in fourth story. Flanking buildings are of conventional flat-slab construction, except that structural steel fireproofed framing is used above fourth-floor level in soap finishing building, which requires large floor openings. Large vessels in soap-kettle structure are unusual outdoor type and project above top of building, as seen in this photograph of scale model.

Los Angeles Processing Plant Utilizes Steel Framing on Top of Concrete Flat-Slab

LESLIE A. IRVIN, Assoc. M. ASCE

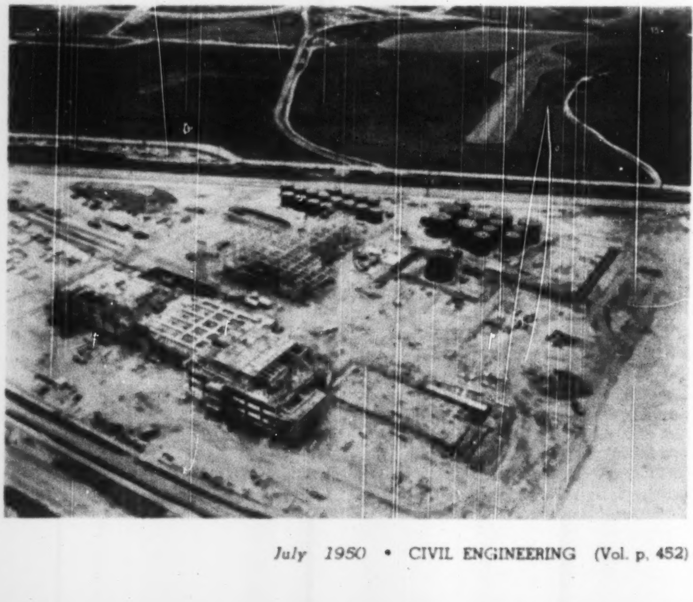
Supervising Structural Engineer, Bechtel Corporation, Los Angeles, Calif.

MARKING ITS ENTRY into the manufacturing field on the West Coast, Lever Brothers Co. has approved final layouts, and construction is well under way for a new Los Angeles plant, which will provide modern production facilities and efficient distribution for its products to western consumers. Now in process of design and construction by Bechtel Corp., this plant will produce a complete line of soap and edible products. The plant is located on a 30-acre site in the central manufacturing district, east of metropolitan Los Angeles, adjoining the Santa Ana Freeway and the main line of the Santa Fe Railway. This location affords an excellent labor market as well as convenient public services.

The plant consists of a four-story office and laboratory building flanked by a five-story soap finishing building on the east, and a six-story edible products finishing building on the west. Common stair towers are used and a 3-in. seismic separation is provided between these buildings. The two four-story refining buildings for each of the basic products are located directly behind the main buildings, separated by four spur tracks and connected by bridges at the fourth-floor level. A boiler and refrigeration plant is centrally located near the center of the site, with service units, hydrogen plant and two tank farms near the rear of the plot. Present construction calls for over 400,000 sq ft of floor space. The site is laid out to provide for the expansion of manufacturing facilities as well as a 185,000-sq ft warehouse. This plant differs from previous soap and edible oil manufacturing plants in that a major part of the refining and processing vessels and equipment are outside.

Investigation of foundation conditions revealed a 10 to 25-ft layer of sand underlying a compressible 12-ft layer of soft clay, indicating the desirability of using drilled concrete piers. Since the use of a foundation pressure of 12,000 lb per sq ft resulted in considerable saving over the conventional type of spread footing, and would produce less settlement, the design was based upon belled piers bearing on the top of the sand stratum.

Although the site is approximately level, it has been necessary to place 60,000 cu yd of earthfill to insure proper drainage. All of this fill has been compacted to 90 percent of maximum density so that future



RAPID PROGRESS is seen in view of plant site taken about two months after view on following page. Administration building is nearing completion in center foreground. At left, soap manufacturing buildings are under construction, and behind is framework of soap processing plant practically completed. Soap tank farm is in right background and edible oil tanks at left. Bechtel Corporation is responsible for design, construction, procurement and installation.

construction may be located at any point and the new grade will in all cases be at least equal in bearing capacity to the natural soil.

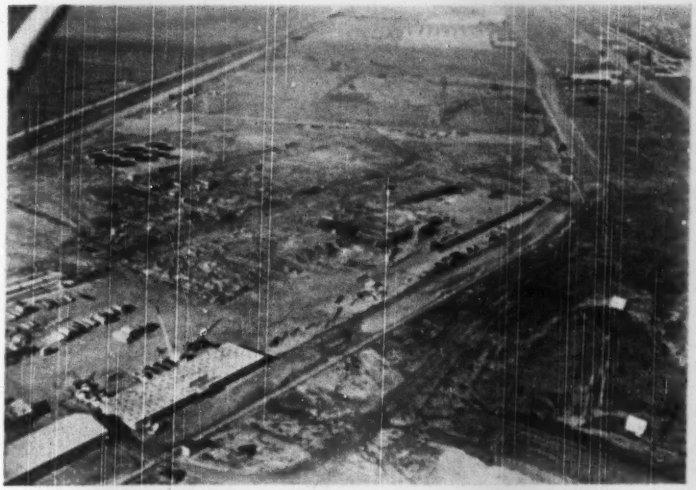
The office building is a flat-slab, concrete-frame structure. Since the front wall columns require a cantilever for their support at the second-floor level and since 40-ft clear spans were a necessity in the upper story, lightweight concrete was used for the fourth-story construction. For this purpose concrete with an ultimate strength of 2,500 psi and a weight of 105 lb per cu ft was selected, using natural sand for the fine aggregate and expanded shale, a lightweight material, for the coarse aggregate. The greater insulating value of such concrete was a factor in determining its selection.

Steel Framing Started at Fourth Floor

The soap and edible finishing and packaging buildings are of conventional flat-slab construction. Special form work is being used on the front elevation to give a fluted effect to the exposed concrete finish. A seven-story tower structure is located within a portion of the soap finishing building. Since there are large vessels and equipment requiring large openings in the floors in this section above the fourth-floor line, fireproofed structural steel framing was used, starting at the fourth-floor level. By starting the structural steel at this level, a saving in cost has been effected. The load is transferred from the steel framing to the concrete framing by 14-in. steel column stubs with shear lugs embedded in the 30-in.-dia concrete columns. All steel framing is of the conventional riveted type with lateral bracing provided by the concrete exterior walls.

A break from tradition in usual soap-plant practice has been made in the soap-kettle structure. The large vessels in this unit are normally placed within a building but in order to take advantage of the mild Southern California climate, an outdoor type of unit was selected. An operating platform suitable for heavy power-truck operation is located near the top of the vessels, 45 ft above grade. This platform rests directly on the top of the columns carrying the soap kettles. Careful consideration has been given to temperature changes as well as to lateral forces.

Seismic factors of 0.33g were used in the design of the vessels, 0.20 in the vessel supports, and a 0.13 for the load on the operating platform. A semi-rigid type of framing was used to resist earthquake loading without transmitting load between vessels.



THIRTY-ACRE SITE chosen for West Coast processing plant of Lever Brothers is in manufacturing district east of metropolitan Los Angeles, near main line of Santa Fe Railway (upper left) and Washington Boulevard (upper right). New Santa Ana Freeway will cut directly across front, or near side, of plant. In this early construction view, taken about two months before photo at bottom of preceding page, preliminary grading has been completed and formwork is in place for second floor of administration building, near center.

Communication is provided between each of the processing and finishing buildings by two bridges of 87-ft clear span. These bridges have been designed for power-truck operation as well as process piping. Because of a change in floor levels, one of the bridges has a slope of 4 ft in its length. This slope has been accomplished by varying the height of the floor beams while maintaining level chords.

A number of classes of concrete are being used, principally of 2,500 to 3,000-psi ultimate strength. The size of aggregate and amount of slump vary with placing conditions. An admixture is being used to increase workability and reduce shrinkage on the exposed concrete walls. Continuous inspection both at the batch plant and at the job site are specified for the transit mix being used. A skip hoist and chute delivers the concrete directly to power buggies at the floor levels. An improved reinforcing bar complying with ASTM Specification A-305 has been specified. Although increased bond stresses were not allowed in the design, since code authorities do not yet recognize their improved performance, the use of these bars will increase the margin of safety of the structure.

Floor Finish Resists Corrosive Liquids

A great deal of consideration was given to the type of floor finish to be used in operating areas, all of which are subject to the deleterious effect of fats and oils. The absorption process, using a $^3/_4$-in. select aggregate topping, is being employed since it produces a hard, wear-resistant surface. In addition a topping finish facilitates replacement in any areas which may be subject to excessive wear.

Slabs on grade are 5 in. thick, poured as nearly as possible without contraction or expansion joints. Contraction joints, cut within 24 hours after pouring the slab, are located about 60 ft apart and consist of a groove made with a carborundum saw to one-third the slab depth. This procedure greatly facilitates pouring of grade slabs since the size of the pour is determined by the capacity of the construction plant, rather than the size of the area within the slab joints specified by the engineer. Precast slabs are being used for service walkways and platforms throughout the oil refineries.

Loads in manufacturing areas were assumed at 250 psf, which is common practice in the industry. In the flat-slab buildings, equipment loads were distributed over their tributary areas plus a reasonable distance beyond, usually 2 ft, to obtain the unit loading of the equipment. When this load exceeded the normal design value, special provision was made to allow for the load concentration.

A study was made of warehousing

materials and arrangement, as well as the capacity of fork-lift trucks. With consideration given to aisle spacing and pallet location, it was possible to reduce this load to 350 psf for slab design. California codes require only a 20-psf roof live load, but all roofs over manufacturing areas were designed for a 100-psf live load to permit the future addition of light equipment.

Provisions of the 1949 Los Angeles County Building Code were followed in determining the amount of earthquake force to be used. This code uses a coefficient, varying with the story height, which is a function of dead load only, except in the case of storage areas in which 50 percent of the storage load is also applied. In general, the lateral loads are carried by floor diaphragms and concrete shear walls. However, in the case of flat-slab construction, where future addition would not permit the use of permanent exterior walls, the lateral load was resisted by moment in the extra-large wall piers. A comprehensive analysis was made to determine the center of gravity of the loads and the center of rigidity of the lateral resisting elements and in this manner determine the amount of load applied to individual walls and columns.

Storm water and liquid industrial wastes are collected separately. Because of the nature of the waste products, it has been necessary to treat all industrial wastes. This is done not only to comply with the regulations of the Los Angeles County Sanitation District but to insure that economic recovery of fats and oils is maintained. Three recovery basins are used. Wastes to be returned to the soap and edible-oil refineries, including floor drains and wash-down from the tankcar unloading stations, are collected separately and treated at aeration-type separators. Recovered oils are returned to process and the effluent is deposited in the sanitary sewer. A skimming basin is used to treat wastes from the tank-farm area. Drains in outside operating areas are provided with manually controlled valves to bypass storm waters directly to the storm drain. Because of the large amount of liquid wastes from the plant, it has been necessary to provide 4,600 ft of 18-in. sewer to reach a main trunk of the Los Angeles County sewer system.

A pedestrian underpass for plant employees is planned for construction under the inlet to the Santa Ana Freeway, which will provide access to transportation services on nearby Washington Boulevard.

Completion Planned for Early in 1951

Construction began in mid-November with grading and installation of underground utilities. The schedule calls for completion early in 1951. The plant is being planned and erected under the general direction of W. H. Burkhart, Vice President in Charge of Manufacturing, C. W. Deane, General Engineering Manager, R. J. Leaver, Construction Engineering Manager, and A. H. Lawrence, Project Engineer for Lever Brothers Co.

For Bechtel Corp., J. K. Doolan, Assoc. M. ASCE, Vice-President; Jerry Komes, General Manager; L. G. Rummel, Chief Engineer; and Earl Nichols, General Construction Superintendent, are supervising this project. Paul E. Jeffers is Consulting Structural Engineer; and Frederick J. Converse, M. ASCE, conducted the extensive foundation tests.

Horizontal Wells Reduce Salt Water Intrusion Into Guam's Water Supply

JOSEPH F. FIL, Jun. M. ASCE

Formerly Second Lieutenant, Reserve, Corps of Engineers; Assistant Post Engineer, Guam

GUAM'S WATER SUPPLY is drawn from a fresh-water lens which has been found to be only about 5 ft above sea level at the edges and 200 ft below sea level at the center. Rainfall, which is the means of replenishing this lens, has averaged about 90 in. per year over a 19-year period. Calculations indicate that for every 1 ft of drawdown there will be an updraw or intrusion of approximately 40 ft of salt water. This fact is an important factor in determining the types of wells to be used and their respective allowable capacities.

The Corps of Engineers operates eight wells and five booster stations of various designs and capacities on the island. Of this total, two wells are of the Maui or horizontal type shown in Fig. 1, 5 are the familiar deep wells, and 1 taps an underground pool

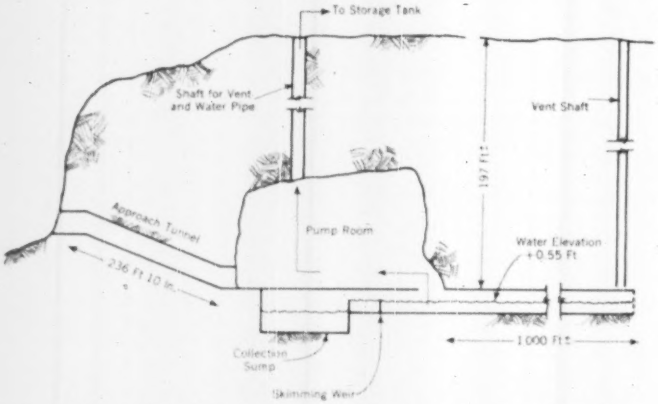


FIG. 1. CROSS-SECTIONAL sketch of horizontal well on Guam illustrates how water is skimmed from top of fresh-water lens. Shaft at right provides additional ventilation for elimination of dangerous fumes caused by seepage of aviation gasoline.

The Tumon Maui Well is designed to skim fresh water from the lens in the permeable reef limestone of the north Guam plateau. Geologic conditions in this area are not favorable to the formation of a large, distinct body of fresh groundwater. Because of the open and permeable nature of the coral, mechanical mixing of fresh and salt water has taken place as the result of both tide action and the movement of rain water. The study of salinity and isohyetal data indicate that rainfall recharges the general groundwater body but does not appreciably freshen the intermediate brackish mixture which this well occasionally draws on.

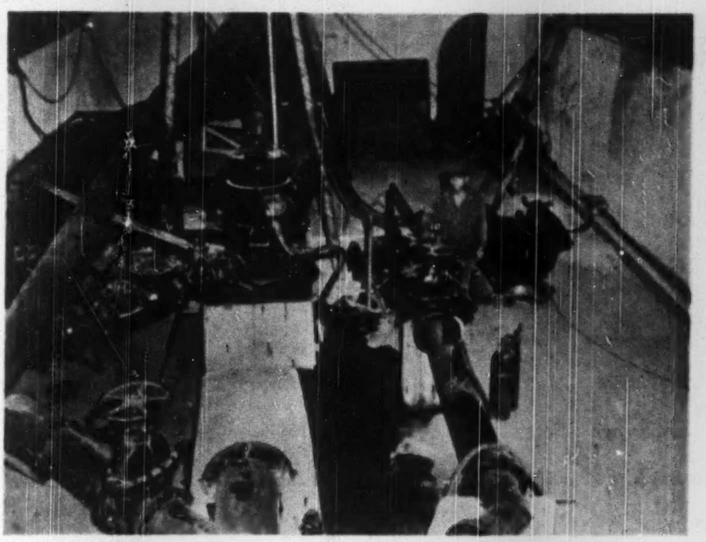
Horizontal-Type Well Skims Fresh-Water Lens

The installation, Fig. 1, can best be described as an approach tunnel 236 ft 10 in. long, inclined at a 30-deg angle, entering from the base of a cliff into an underground room housing the pumps. This room is 17 ft × 55 ft 4 in. and 27 ft 6 in. high, with neither support nor reinforcement used. The floor, of reinforced concrete construction, is 18 in. thick and covers the collection sump. Water flows into this sump from a horizontal tunnel 1,000 ft ± in length, extending into the interior. The water table is usually maintained at an elevation of + 0.55 ft throughout the tunnel but the level is dependent on rainfall and tidal conditions. Water is pumped from the pump room up a shaft into a 420,000-gal steel storage tank where it is chlorinated and put into the distribution system. At present, the pump room contains two 1,000-gpm low-lift centrifugal pumps and one 300-gpm vertical pump, all three electrically driven.

The well is now being ventilated by two 15,000,000-cu ft explosion-proof fans and one 10,000,000-cu ft explosion-proof fan. Noxious fumes from the seepage of aviation gasoline from the nearby air field and from aviation gasoline pumping installations present a hazard. Dangerous fires have been caused in the well when the fumes were accidentally ignited. For this reason, a vent shaft 15 in. in diameter and 197 ft deep has been drilled into the interior end of the skimming tunnel, and another exhaust fan installed there.

Wide Variety of Pipe Used

Many different types of pipe have been used in Guam's water system as the war stock piles do not always contain the specified variety. Steel, cast iron, combat pipe and a pipe combining asbestos, cement and silica are among those in common use throughout the system. A large amount of pipe was laid shortly after the liberation for temporary use, but because of changing situations is still in use and is standing up under adverse conditions remarkably well. Breaks in the main line, which were caused by an insufficient number of air-release valves and pressure surges, have been held to a minimum by the expedient of replacing brass bolts on the flanges with steel. Numerous air-release valves are a necessity because some of the equipment was installed hurriedly to provide for a specific need. Air-tight suction lines, although a desirable prerequisite, are not always an actuality.



TUMON MAUI WELL pumproom contains two 1,000-gpm low-lift centrifugal pumps, and one 300-gpm vertical pump, all electrically driven. Well skims water from top of fresh-water lens on island of Guam, thus reducing salt-water intrusion. Salt water intrudes about 40 ft for every foot of drawdown.

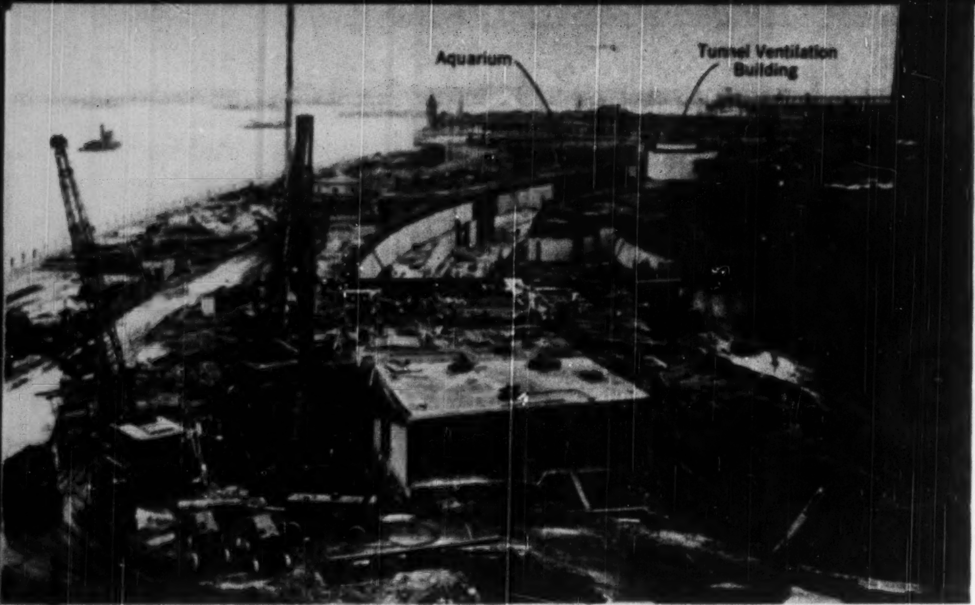
Application of Chlorine

Water-borne diseases caused by bacteria, protozoa and viruses are quite prevalent in the Far East. On Guam there are a large number of pit latrines and cesspools and because of the exceedingly permeable nature of the coral, the groundwater is easily contaminated. Of the various methods of purifying water, chlorination has been found to be one of the most efficient and economical. All water in the Army-operated system is sterilized with chlorine. Since no other treatment is given to the water, a residual of not less than 2.0 ppm of free available chlorine is maintained after a contact period of not less than 30 minutes. Normally chlorine is applied by mechanical means but because of its corrosive nature and the deteriorating effects of the tropical climate, manual application of calcium hyperchlorite is sometimes employed. Comparators are used by all the water point operators and the water is frequently tested.

Water Quality Checked by Tests

Periodic bacteriological examinations of the water, and salinity and potability checks are carried out at numerous points throughout the systems by a sanitary engineer. All the analytical work is done in accordance with the latest standard methods of water analysis approved by the Public Health Association or by the Surgeon General of the Army. The study of salinity reports during the dry season serves to determine proper pumping procedures to avoid excessive drawdowns.

One of the more serious deficiencies is the lack of adequate, properly located storage facilities. There are only two reservoirs, one with a capacity of 1 million gal and the other with a capacity of 2 million; both are of reinforced concrete construction. Natural storage facilities are nonexistent in the Army sector because of the exceedingly permeable nature of the ground, and steel and wooden tanks, with a total capacity of 1,613,000 gal, are used at different points in the system.



EXCAVATION for Battery Underpass cuts through Battery Park, skirting old Aquarium and Ventilation Building for Brooklyn-Battery Tunnel. Note superelevation of roadways in twin barrels of vehicular underpass structure.

East Meets West Through New York's Battery Park Underpass

JOSEPH MELTZER, M. ASCE

President, National Structures Corporation, New York, N.Y.

MANHATTAN'S East and West Sides will soon meet at the southern tip of the island via the new vehicular Battery Underpass, which crosses over the new Brooklyn-Battery Tunnel to connect the West Side Highway with the East River Drive (see Fig. 1). Traffic which previously had to creep through the overloaded streets of lower Manhattan can now move rapidly through the underpass, which at its western approach is connected with the entrance to the recently opened tunnel (see item, page 57 of this issue). Thus both East and West Side traffic can proceed on around the island or directly to Long Island from this point.

In its total length of about 3,000 ft, the Battery Underpass passes over two subway lines, the Interboro Rapid Transit and the Brooklyn-Manhattan Transit, as well as the Brooklyn-Battery Tunnel, and crosses under several streets. At the point where it crosses the tunnel, that structure is in rock about 40 ft below the bottom of the underpass structure, so that no construction problem arises. At both the subway crossings, the top of the subway is only about 3 ft below the bottom of the sewer of the underpass (Fig. 2), requiring special reinforcing in the floor of the underpass so that it will impose no load on the subway structure. As the top slab of the underpass is heavily reinforced throughout with 1 1/4-in. square steel rods 6 in. on centers, no additional strengthening is required where streets pass overhead.

The Battery Underpass will provide two lanes for traffic in each direction (Fig. 2). The width of each two-lane barrel varies from 22 to 24 ft at the floor level and between 25 and 30 ft at the roof level. The minimum height of the finished underpass is 14 ft, but the height varies because of the superelevation of the roadway on the outside of the curve. Except for about 1,000 ft, the entire length is curved or spiraled, with a 600-ft minimum radius.

In preparing the estimate, the contractor was able to use the knowledge of subsoil conditions gained from the Brooklyn-Battery Tunnel approach cut nearby. It was assumed that the excavation would attract surface water and tidewater from inundated ground in the vicinity as well as seep-

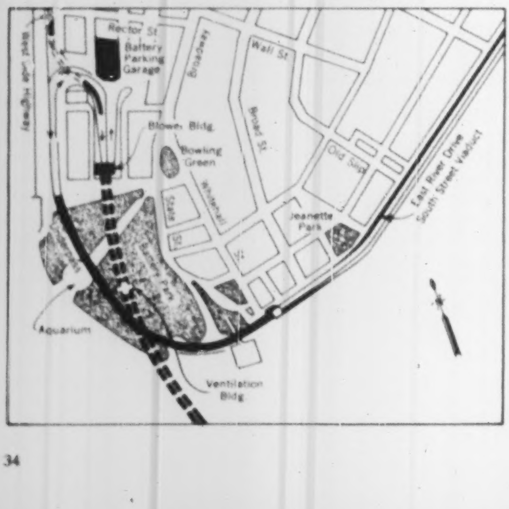
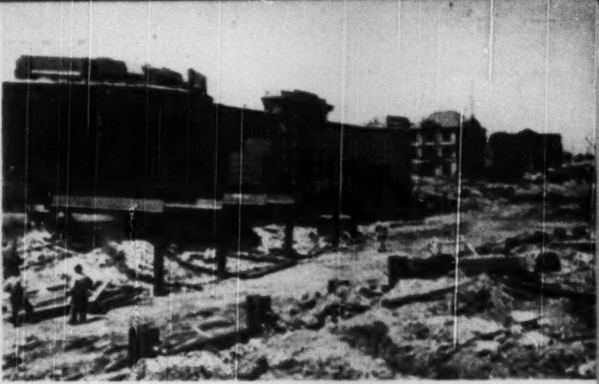
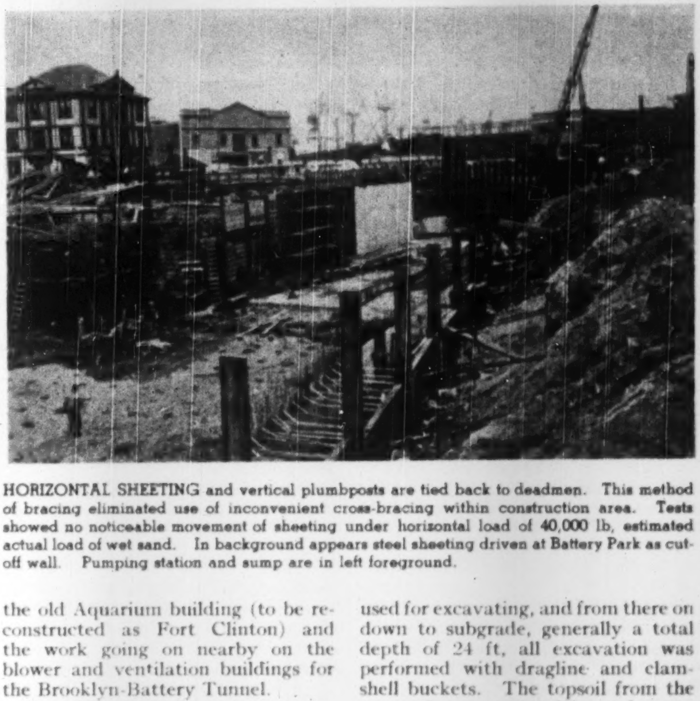


FIG. 1. BATTERY UNDERPASS (solid black line) circles southern tip of Manhattan, joining West Side Highway with East River Drive. New route eliminates circuitous trip through traffic-packed streets and connects with approach to recently opened Brooklyn-Battery Tunnel (indicated by dashed lines). Project will cost city $9,587,000, and is expected to open in September of this year.

DRAGLINE AND CLAMSHELL excavate cut in which concrete underpass structure will be built. Good material coming from excavation was stored in park area for use as backfill. Other material was trucked to scows for disposal at sea.



NEEDLE BEAMS and H-columns support walls of famed old Aquarium (to be restored as Fort Clinton) prior to excavation for underpass. Seepage through riprap under Aquarium made it necessary to dig sump within its walls.



HORIZONTAL SHEETING and vertical plumbposts are tied back to deadmen. This method of bracing eliminated use of inconvenient cross-bracing within construction area. Tests showed no noticeable movement of sheeting under horizontal load of 40,000 lb, estimated actual load of wet sand. In background appears steel sheeting driven at Battery Park as cut-off wall. Pumping station and sump are in left foreground.

age through the old and new seal walls. Three pumping stations, each containing two 10-in. pumps, were thought to be sufficient to keep the excavation dry. Both gasoline and diesel pumps were considered, and both types are in use. The diesel pumps have proved very economical both in maintenance and in fuel consumption.

Four bids were received, the low bid of $9,587,000, made by the National Structures Corp. being about a million dollars lower than the next higher bid. The reason for this large difference was that the low bidder anticipated a leveling of material prices at a time when the market was still rising. Later events proved the correctness of this expectation. In the ensuing month, labor was plentiful and very cooperative, and the material market, although stiff at first, eased up toward the latter part of 1949. To assure stable prices for the subcontract work, which amounted to about $2,500,000, the subcontracts were closed as soon as the job was awarded. No advantage was gained therefore when subcontract bids dropped slightly later in 1949. Material orders also were closed soon after the awarding of the contract, although some of the orders included a clause stating that the price would be that prevailing at time of shipment.

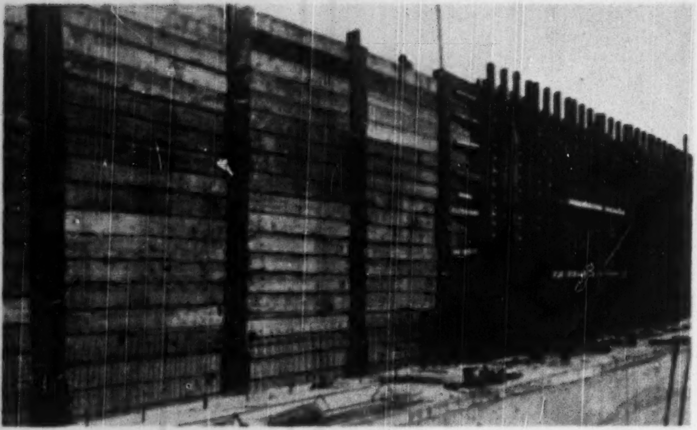
Work started immediately after the award was made and the contract delivered, although it was the middle of winter. Ground was broken on January 31, 1949, despite an 11-in. snowfall, and from then on the excavation proceeded with speed using one 2-cu yd shovel and at times up to seven additional cranes.

The work began in the neighborhood of the Aquarium and progressed eastward. The original plan, to work both ways from the middle, had to be abandoned because of difficulties connected with the underpinning of the old Aquarium building (to be reconstructed as Fort Clinton) and the work going on nearby on the blower and ventilation buildings for the Brooklyn-Battery Tunnel.

For this cut-and-cover construction in sandy and very unstable ground, the contractor elected to use 4-in. horizontal sheeting supported by 14-in. 78-lb H-beams, called plumbposts, driven approximately 10 ft on centers. The plumbposts were driven after the first cut was made, that is, when the excavation had reached a depth of about 10 ft. Where decking was required to carry West Street and South Street across the cut, bracing was carried right across the cut and supported on H-beam center posts.

For the first 8 ft down below the original ground level, a shovel was used for excavating, and from there on down to subgrade, generally a total depth of 24 ft, all excavation was performed with dragline and clamshell buckets. The topsoil from the excavation was stored in park areas to be used later for backfill, since the park will extend over the bulk of the underpass, and the rest was trucked to scows for disposal at sea.

Within the park area, tiebacks were used instead of cross bracing. Tiebacks consisted of 14-in. H-beams driven opposite and about 20 to 30 ft in back of each plumbpost, each H-beam and plumbpost being tied together by two strands of $^7/_8$ to $1^1/_8$-in. steel cable and 3-in. turnbuckles. This tieback method was tested to prove its feasibility and strength both to the engineers and to the contractor.



FORM PANELS are in place prior to pouring of outer or protection wall, called sand wall. Steel plumbposts are protected from concrete by greased paper so that they can later be pulled out. Spikes driven into horizontal sheeting keep 6-in. protection wall from being displaced when plumb posts were removed.

Test tiebeams were driven and subjected to forces exerted by two 50-ton jacks pressing against two other deadmen. The movement of the tiebeams was measured as the pressure was applied. A pressure of 40,000 lb was applied before any movement was noted; after 50,000 lb, the H-beam moved ¼ in.; and after 60,000 lb, it moved 1 in. Since the theoretical pressure on the H-beams due to wet ground was 40,000 lb, it was decided to add 2 in. to the design thickness of the sand wall (or outer side-wall protection, Fig. 2), increasing it from 4 in. to 6 in. Thus, if the plumbposts should move at all, the concrete protection on the outside of the structure proper would be 4 in. These assumptions were justified by actual job conditions. The tiebacks held and the H-beams remained practically as driven, which facilitated their removal after the underpass roof slab had set for several months.

When the bottom of the excavation was reached, piles were driven for the support of the structure for about 1,700 ft of its 3,000-ft length. In almost every case the piles were driven to rock. Where the distance between the bottom of the structure and the rock was less than 5 ft, the piles were omitted. Piles range in length from 6 to 50 ft and are generally 5 ft on centers both ways. About 100,000 ft of piles were driven, or about 4,600 piles. All the pile driving was done by one No. 1 Vulcan hammer sitting at subgrade, and was completed in October 1949.

After the piles were driven, a 6-in. layer of broken stone was placed at subgrade, followed by a 9-in. concrete pile cap, reinforced both ways, on which one layer of waterproofing and two layers of brick in asphalt mastic were placed. Where the piles were omitted, the pile cap became a 6-in. concrete protection mat.

Drainage of the cut was obviously important. The intercepting sewer, being about 7 ft below the bottom of the main cut, helped to drain it, but the bottom of the sewer itself had to be drained. It should be noted that the sewer was included within the underpass structure, that is, within the waterproof envelope which completely surrounded the structure. One, and sometimes two, 12-in. clay pipes had to be placed as underdrains under the broken stone of the sewer bottom to lead the water from the high points to sumps at the low points. Sump water was pumped out to the river.

A great deal of water came into the cut through the large amount of riprap under the Aquarium building. To keep this water out it was found necessary to place a sump inside the walls of the Aquarium itself. Since the small size of the building's entrances would not accommodate trucks, a ramp was built to the top of the Aquarium wall so that cranes, pumps and pile driver could be lowered inside. The sump, accommodating three 10-in. pumps, was built below the subgrade of the main cut, and water was pumped from it 24 hours a day, seven days a week for a period of about seven months.

Concreting of the pile cap was performed directly from ready-mix trucks by pouring through elephant trunks, which were heavily reinforced and held in place by ropes. The sand wall and the sidewall proper were poured directly from the ready-mix trucks by means of hoppers with extended nozzles. The center wall was placed by cranes and buckets, and the roof was placed directly from the ready-mix trucks.

Weekly Concreting Cycle Planned

The concrete forms were designed in panels so that they could be moved from expansion joint to expansion joint, and the work was laid out in sequence so that a complete cycle could be finished in one week. A

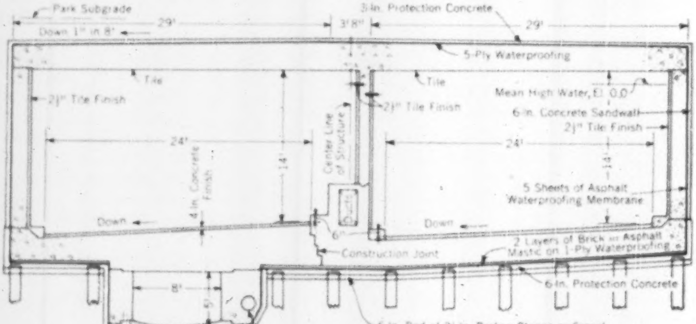

Park Subgrade
29'
Down 1" in 8'
3'8"
3-In. Protection Concrete
29'
5-Ply Waterproofing
Tile
2¼" Tile Finish
24'
4 In. Concrete Finish
14'
Center Line of Structure
Ducts
Down
6"
Construction Joint
Tile
2¼" Tile Finish
Mean High Water, El. 0.0
6-In. Concrete Sandwall
2¼" Tile Finish
24'
14'
5 Sheets of Asphalt Waterproofing Membrane
Down
2 Layers of Brick in Asphalt Mastic on 1-Ply Waterproofing
6-In. Protection Concrete
8'
9'
6-In. Bed of 2¼-In. Broken Stones or Gravel
12 In. Cast Iron Drain
6-In. Protection Concrete
6-In. Broken Stones or Gravel

FIG. 2. NEW YORK'S Battery Park Underpass consists of twin barrels of two traffic lanes each. Walkway, here seen in left-hand barrel, shifts from one side of dividing wall to the other side each 60 ft, requiring use of hinged center panels on roof forms. Because of nearness of river and permeable nature of sand, structure, including sewer, is completely surrounded by envelope of waterproofing. In addition, at bottom there are two layers of brick in asphalt mastic.

cycle embraced: (1) Protection concrete in pile cap and sand walls; (2) concrete base; (3) bench; (4) center wall and side walls of structure proper; and (5) roof slab. Since there are 52 expansion joints, this program calls for completion of the roof, which is the lifeline of the job, in 53 weeks. Because of some delays caused by holidays and underpinning of the Aquarium building, it has been impossible to keep to this schedule invariably, but in the main it has been maintained.

Formwork for the side walls, benches, center wall and sand walls was simple and was erected and dismantled by cranes. This formwork was designed by the contractor.

The concrete roof presents a more difficult problem because it includes the tile facing for the ceiling on the inside of the structure. According to the specifications, the tile must be placed face down on the inside of the form, followed by mortar, mesh, reinforcing and roof concrete.

To protect the tile from the weather before completion of concreting, a canvas tent 70 × 90 ft was designed, with plastic windows and ropes leading from the ends. This tent is supported by pipe beams to allow room for the men to place the tile and put the mortar and mesh on top for protection and anchorage to the concrete. When the weather is bad, the tent remains in place until the wire lathers have placed the reinforcing rods. The tent is removed for the placing of roof concrete, which goes forward rain or shine. The roof is about 30 in. thick, and each pour between expansion joints contains 400 cu yd of concrete and 25 tons of reinforcing rods.

To facilitate placing of roof concrete according to the weekly schedule previously outlined, Blaw-Knox steel traveling forms having a steel skin plate are used, and $^3/_4$-in. plastic plywood is placed on the skin plate. The form travels on rails which rest on timbers on the base of the structure.

Because the $2^3/_4$-ft-wide walkway along the center wall shifts from one barrel of the underpass to the other every 60 ft, it is necessary to use hinged jacknife panels for the center of the roof form. These panels can be swung from one side to the other as required. Because the structure is mostly on a curve, so that the width of the roof varies, edge pieces which can move inward or outward are used at the corners to make the forms tight and permit their use in various positions. Relocation is accomplished by ratchets on the inside of the forms and by steel channels.

WORKMEN PLACE final reinforcement prior to pouring of section of roof. Entire operation was keyed to cycle of one section of roof (from expansion joint to expansion joint, about 60 ft) per week. Canvas in background stretches out to form pipe-supported tent 70 by 90 ft which protects face-down tile for roof lining from elements prior to pouring of top slab.

To help meet the weekly schedule established for pouring the roof concrete, five operations leading up to the pouring were planned as follows: (1) The forms were moved into place and adjusted on Monday; (2) tile was laid early on Tuesday; (3) mortar and mesh were placed later on Tuesday (these operations were performed under the tent); (4) reinforcing rods were placed on Wednesday and Thursday; and (5) the concrete roof was poured on Friday. Immediately after pouring, the concrete was vacuum treated, adding 20 percent to its strength and speeding setting by 50 percent.

Index markers were placed on the inside at the middle of the roof form every 10 ft during concrete placing so that the deflection in the long spans could be measured. On a 28-ft span the maximum deflection found was $^1/_4$ in. The allowable deflection was $^7/_8$ in.

Test Roof Section Erected

Before the concrete work was started, in the winter of 1948–1949, the contractor erected a sample roof 3 ft wide, 30 in. thick and 30 ft long to try out his projected procedure and indicate both to himself and to the engineers whether or not it was practicable. After the soffit forms were constructed on sturdy supports, the tile was placed on the forms face down as called for in the contract; next the mortar, mesh, and rods were placed, and finally the concrete was poured. As soon as the top of the concrete was struck, the vacuum system was applied, with the result that in one hour the concrete was sufficiently consolidated so that it could be walked on. When the forms were struck 72 hours afterward, the deflection in the center of the beam was found to be $^1/_4$ in. the allowable deflection for a 30-ft span being 1 in. Sample cores were 20 percent above the required strength.

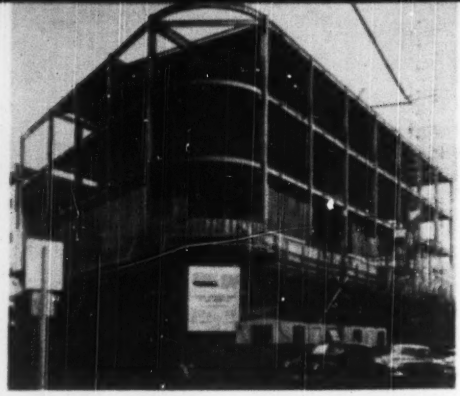
As of June 15, forty-five of the fifty-three sections of the underpass structure have been concreted, and the work that the National Structures Corp. is performing with its own forces is 85 percent complete. The total contract, including subcontracts for park and electrical work, is 80 percent complete. The entire underpass is expected to be ready for vehicles in the fall of 1950. The contract as a whole is about 90 days ahead of schedule as of June 15.

The whole contract is under the supervision of the President of the Borough of Manhattan. When the work began the Borough President was Hugo E. Rogers, and the Chief Engineer, Michael Klein, M. ASCE. The present Borough President is Robert F. Wagner, Jr., and the chief engineer, Anthony J. Donargo. Indirect supervision is by Assistant Chief Engineer P. Rizack, and field supervision by John T. Carroll.

For the contractor, the National Structures Corp., the chief engineer and superintendent is Ralph J. Taylor and the designing engineer, Edward B. Fitzpatrick, M. ASCE. The entire operation is under the supervision of the writer, president and general manager of the corporation.

Earthquake Resistant Design Incorporated in Portland, Ore., Bank Building

R. EVAN KENNEDY, Jun. M. ASCE
Design Engineer, Cooper & Rosé, Portland, Ore.



DESIGNED TO RESIST Zone 2 earthquake loading, building in Portland, Ore., houses branch of Federal Reserve Bank of San Francisco. Lugs on spandrel beams anchor concrete exterior walls to steel skeleton, so that both work together to resist seismic loads. Because of stiffness of exterior walls, interior column-to-beam connections take only minor moment loads.

A CURRENT DESIGN for an earthquake loading of Zone 2 intensity, as defined by the Pacific Coast Uniform Code, roughly equivalent to a horizontal acceleration of 0.05g, is well represented by the building now under construction in Portland, Ore., for a branch of the Federal Reserve Bank of San Francisco.

The frame is a steel skeleton designed to take the full vertical loading and a part of the horizontal earthquake loading. Horizontal loading is taken by a combination of the two structural materials available—the steel frame and the concrete walls. To get the horizontal shear to the structural elements handling the load, Robertson steel deck flooring is used. Investigation indicated that this deck would possess sufficient strength to carry the shear flow except in the bays of shear accumulation, which are reinforced with horizontal diagonal bracing. The horizontal shear is thus carried to the stiff bents by diaphragm action augmented by angle bracing where necessary.

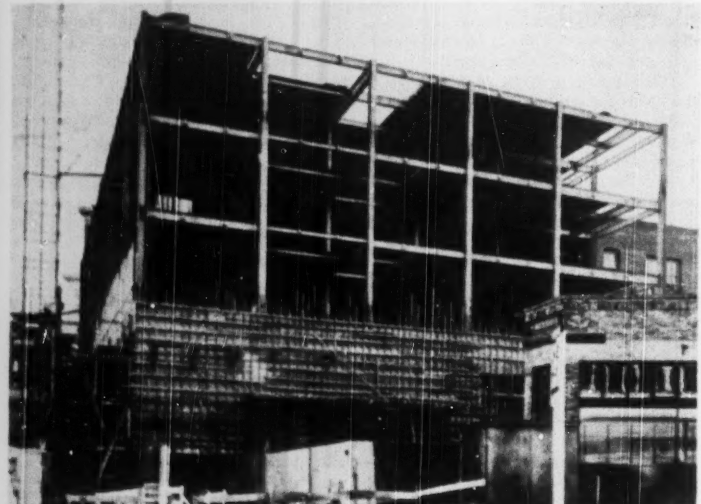
A study of the architectural plans showed that the concrete walls in the exterior frames could be made sufficiently strong to warrant their use in aiding the resistance to horizontal loading and could thus be utilized in the seismic design to economically increase the efficiency of the earthquake resistant structure. To insure that the walls and the steel frame would act simultaneously in taking seismic loads, the steel and the concrete were securely bonded together.

Using this approach the relative stiffnesses of the bents were next determined. Analysis showed that the bents stiffened with concrete walls provided approximately 98.2 percent of the total available stiffness in the north-south direction, and 95.5 percent of the total available east-west stiffness. It then became necessary only to add the proper moment connections to the steel frames so as to insure their acting as continuous bents and taking their share of the horizontal load. Since their stiffness was such a small part of the total, their horizontal loading was small and their required moment connections were of a minor nature.

This design requires care in anchoring the concrete to the steel. For this purpose, anchor lugs are placed on the spandrel beams, and the wall reinforcing steel is passed under the lugs. In addition, the concrete walls are anchored to the columns with U-shaped stirrups and the concrete walls themselves have seismic steel reinforcing bars around all openings in addition to the usual wall steel.

The building is being constructed to a height of four stories, but is designed for an ultimate height of seven. The erected steel weighs 700 tons. The total volume of the present building is 4,498,000 cu ft with a total supported floor area of 117,400 sq ft. The resulting tonnage of 12 lb per sq ft of supported floor reflects the economies effected by using the concrete walls to stiffen the bents as has been outlined.

Steel was furnished and erected by the Gunderson Brothers Steel Co., and the general contract was held by the Ross B. Hammond Co., both of Portland, Ore. The Architect was Pietro Belluschi. Structural engineering was in the hands of Cooper and Rosé, of Portland, with the writer as design engineer.



ROBERTSON STEEL DECK flooring transmits seismic shear loads to stiff bents of steel skeleton. Bays of stress accumulation are reinforced with horizontal diagonal bracing visible under flooring.

Successful Engineers Never Stop Learning

WEBSTER N. JONES
Dean, College of Engineering and Science, Carnegie Institute of Technology, Pittsburgh, Pa.

THE ENGINEER is a member of a profession that prides itself on its scientific, humanistic, and technological achievements, and on the individual responsibility assumed by its members to apply free, resourceful, and unhampered intelligence to the solution of its problems. Our profession includes men of stature—who have never stopped learning or giving—men like "Boss" Kettering and Herbert Hoover. Every young engineer should aspire to professional competence such as they have attained, and the mature engineer—whether industry, government, or teaching—should help him achieve it.

Responsibilities to Young Engineers

The college, the employer, and the professional society have definite responsibilities in the development of the young engineer, particularly as they can help him to acquire and to maintain healthy attitudes toward his work and toward life in general. How can we cooperate to foster such attitudes? How can we create in him the desire for education as a continuing process upon which his professional growth will depend?

The role of the college is to help the student learn to think and to equip him to go on learning after graduation and to grow throughout his life in professional and personal stature and in usefulness as a citizen. How well the college does its job depends to some extent upon the physical plant, and upon the academic program, but far more importantly upon the quality of the teacher and the quality of the student and the way in which they work together. The inspiration and the example of a fine teacher are the secrets underlying many a man's success. The teacher must want to teach *men* primarily—not subject matter—and he must have personal characteristics that will command respect and admiration. He cannot teach disciplines pertinent to the student's chosen field without first arousing the interest of the student and then helping him to maintain that interest. If a student likes his work, and if he can be made to see that he learns only from what he himself thinks and does, the problem is simplified, and the young engineer has a good start on the engineering route.

College can give the embryo engineer a good start, but many of the fine influences of college can be lost if the industry he enters does not show a personal interest in his continued development. I firmly believe that in industry, just as in college, the young engineer should be in daily contact with men he can admire and emulate. Perhaps the most significant aspect of training is arranging manpower so that the beginners are intimately associated with those who are skilled and possess the rare ability to teach others. Such relationships do occur in industry—perhaps more frequently by chance than by design—but everything should be done to foster them.

Professional societies have much to offer beginning engineers. They provide an excellent opportunity for young men to mingle—often on an informal basis—with other and older members of the profession, and to learn from them both about technical engineering and about that even more complex engineering task—the task of designing, building and maintaining an intelligent, adjusted life. The young engineer can contribute to his profession and incidentally to his own growth and reputation by writing for professional journals; and by working in the professional societies, he can keep himself constantly aware of the standards, the purposes, and the ethics of his profession.

Seven Basic Rules for Success

The engineer-in-training, under proper direction of engineers of fine character and high ideals, can establish healthy attitudes for himself—a set of basic rules to lead him to success in his work and in his living. Those rules might be something like this:

CAPSULE ADVICE TO THE YOUNG ENGINEER:

1. **Guard the privileges of freedom at all times.**
2. **Take pride in yourself and your profession.**
3. **Be loyal to your employers and associates.**
4. **Try to develop vision as well as technical ability.**
5. **Study people and learn to work with them.**
6. **Watch three things—your health, your appearance, and your tongue.**
7. **Never stop studying and learning.**

First, he should remember that he is a *free* man working for *private enterprise* in a nation which makes *human freedom* its primary concern. He should guard this privilege at all times by his thoughts and by his actions.

Second, he should take pride in himself and in his profession, and should not sell either of them short. He must realize that the engineer is essential, and is responsible for much of the world's progress and for the success of many of our country's largest industries. He must know his possibilities and also his responsibilities as a member of the profession.

Third, he should be loyal to his company, his superiors, and his associates; give himself completely to every job he does; do *more* than he is asked—never *less*. He should fight hard for what he thinks is right, but should learn to carry out the decisions of his superiors if his is overruled. He should give his subordinates a break by defining their tasks clearly, letting them have the authority necessary to discharge their responsibilities, and giving complete and unmistakable recognition to their work.

Fourth, he should try to see the forest as well as the trees. He should spend time not only on his immediate assignment but also on thinking about the long-range problems of his company. His employer knows that he can think, but hopes that he will also have vision. The methods he has learned to use on engineering problems are equally applicable to other problems of his company—problems of advertising, selling, accounting, and personnel.

Fifth, he should study people and learn to work with them. Engineers get things done by teamwork. There are fewer and fewer corners for individualists. The young engineer should know the strength of men as well as he knows the strength of materials.

Sixth, he should carefully watch three things—his health, his appearance, and his tongue.

Seventh, and finally, he should always keep in mind that the price of success is hard work; therefore, he

(*Continued on page 77*)

Rental Charge Expedites Philadelphia's Sewage Treatment Program

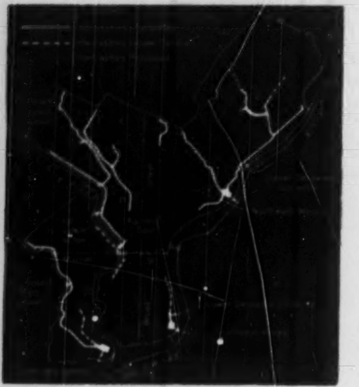


FIG. 1. **THREE sewage treatment plants, each of 125-mgd capacity, are included in Philadelphia's ten-year 60-million-dollar program to protect its water supply and to clean up the Delaware and Schuylkill Rivers in its vicinity.**

SAMUEL S. BAXTER, M. ASCE

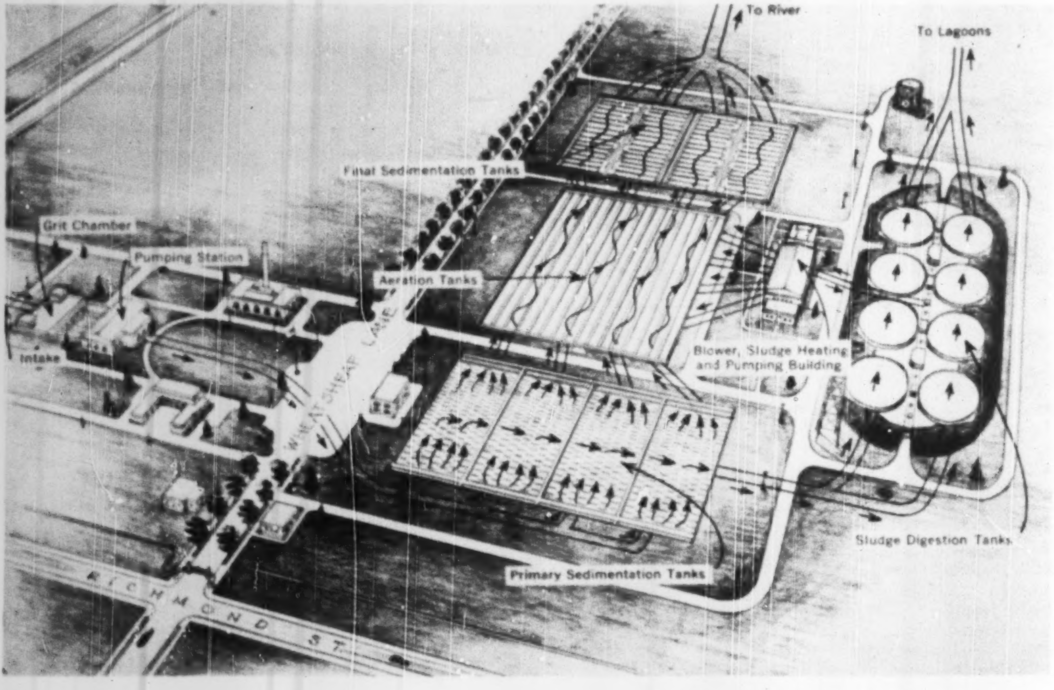
Assistant Chief Engineer, Bureau of Engineering, Surveys and Zoning, City of Philadelphia, Pa.

ADEQUATE FINANCING proved the key which permitted Philadelphia to plan and work for the completion of its sewage treatment program. The $60,000,000 postwar program which began in 1947 owes its start to the enactment of a bill authorizing a sewer rental charge, which placed the sewer and sewage treatment projects on a self-sustaining basis. This act has permitted the sale of bonds apart from the general-obligation bonds of the city. Lack of available borrowing capacity had stymied full-scale work on the program, which dates back to 1925. This program is expected to be completed and the plants to be in operation by the end of 1953. The Northeast Works is planned to open in September 1950.

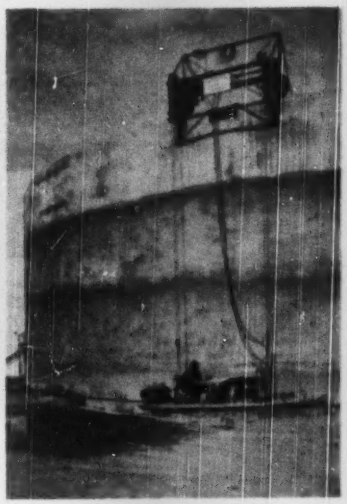
Treatment of sewage will be carried on at three plants (Fig. 1) of approximately equal size—125 mgd. Two of the plants, the Northeast Works and the Southeast Works, will serve the Delaware River watershed. The third, known as the Southwest Works, will serve the Schuylkill River watershed. The effluent from all three plants will discharge into the Delaware River. The respective acreages of these plants are 160, 60, and 800.

Although the Delaware River intake for Philadelphia's water supply

FIG. 2. **NORTHEAST WORKS, scheduled to be put in operation in Philadelphia this fall, will screen raw sewage in grit chamber, then lift it 36 ft to primary sedimentation tanks where mechanical scrapers remove sludge from bottom and sweep scum off top. In aeration tanks, air from blower building is forced into sewage, which then flows to final sedimentation tanks. Mechanical scrapers remove remaining sludge, which is collected, heated, digested in tanks, and disposed of in lagoons. Effluent discharges into Delaware River.**



PHILADELPHIA'S NORTHEAST WORKS, which was begun in May 1947, will be completed early in 1950. Contractor handled construction with 20-ton overhead cableway of 1,300-ft span traveling on 1,000 ft of track. Cableway placed concrete by 5-cu yd buckets hauled from central mixing plant 1½ miles from job. Aeration tanks are here seen under construction in foreground and final sedimentation tanks in background.



ONE OF EIGHT 110-ft-dia sludge digestion tanks, 38 ft high, is prestressed at Northeast Works. Continuous wire is pulled through die on carriage which reduces its size from 0.16 in. to 0.14 in., thus producing desired tension. Strands of wire varied from 68 to the foot at the bottom to 2 per foot at the top. Wires are covered with Gunite.

was far enough up the river to be safe from contamination from city sewage at the time it was built, the growth of the city and tidal flow later caused some concern as to its safety. A treatment program was therefore decided on, and the Northeast Sewage Treatment Works was scheduled as the first stage.

Work on this plant was started in 1916, but because of the first World War and the failure of a contractor during the postwar period, the plant did not begin operation until 1923. This plant, still in operation, provides sedimentation in Imhoff tanks and sludge drying. The original design capacity of 60 mgd has been stretched at times to a maximum of 90 mgd.

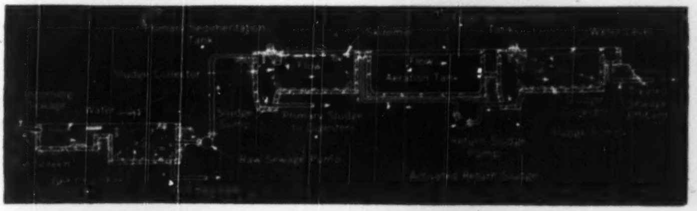
Sewage for this plant is collected by interceptors built along the entire Delaware River waterfront and along creeks entering the river. Some interceptors were built in connection with the existing treatment plant and others have been completed since. Interceptors valued at $2,275,000 are completed or under contract.

Original construction at the Northeast Works provided an administration building, screens, grit chamber, pumping station, heating plant and auxiliary buildings in addition to the Imhoff tanks. Sewage from the Tacony Creek interceptor enters the plant at high level after passing through a separate screen and grit chamber. The remaining sewage is lifted by the pumping station a maximum height of 36 ft.

Faced with further pollution of the Delaware River and a demand from the state for a higher degree of treatment, the city decided to change the existing 60-mgd Imhoff installation to a plant capable of handling 125 mgd. The desired degree of treatment appeared to be that which would reduce the average suspended solids in the raw sewage from 200 ppm to 50 ppm, and the B.O.D. from 200 to 50. Chosen to meet these requirements was a plant of the modified aeration type providing primary sedimentation, aeration, final sedimentation and sludge digestion.

Full consideration was given to conversion of the Imhoff tanks into primary sedimentation tanks. However, because of some deterioration in the Imhoff units and the problems of adapting these two-story tanks to primary work, it was found that new tanks would cost no more than the necessary changes in the old tanks. Consequently the Imhoff tanks are to be scrapped and new treatment units built. Sufficient land is owned by the city to permit this procedure. All the existing screens, grit chambers, pumps, and buildings will be used in the new plant.

FIG. 3. **FLOW DIAGRAM** for Northeast Works illustrates two-stage sedimentation process.

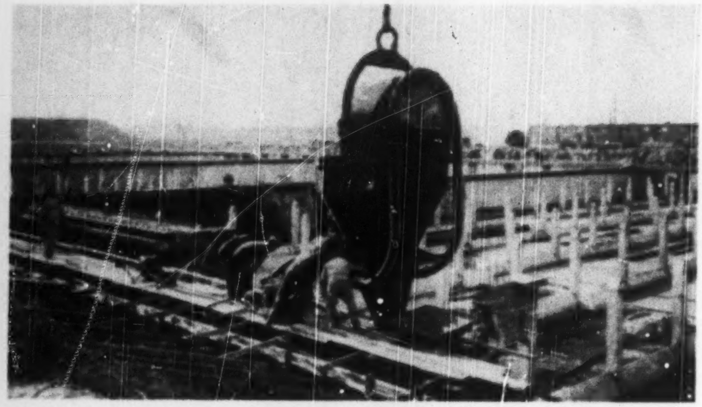


Work on the primary, aeration and final tanks started in May 1947 and was completed early in 1950. Separate bids were taken on the construction and mechanical work, but the same contractor was the low bidder on each of these items.

Borings indicated sand and gravel, with some clay, at foundation level and the groundwater level about 9 ft above the bottom of the structure. The contractor surrounded the entire area of the aeration and final tanks with well points, which so effectively lowered the water table that he had to use water carts on the subgrade at times before placing the bottom slab of concrete.

The well points were driven about 25 ft deep and attached to a header pipe, leading to the pumphouse, which contained three pumps with a total rated capacity of 6,000 gpm. One pump was held in reserve and two were operated continuously, discharging through two 12-in. pipes.

EQUIPMENT FOR introducing air into sewage in aeration tanks at Northeast Works consists of distributor pipes and swing diffusers.



SECTION OF WALL for primary tank at Northeast Works is poured by means of overhead cableway, which carries 5-cu yd concrete bucket to exact location required.

The bottom of the primary tanks was about 7 ft higher than the aeration and final tanks and groundwater in this area was handled by a sump.

Steel forms are used in the construction of the walls and other shapes in the main tanks. Flange edges on the forms, perforated for the insertion of small clamps, permitted the edges of adjoining pieces to be tightly brought together to form a continuous surface.

The eight circular sludge digestion tanks are each 110 ft in diameter and 32 ft high. The contract permitted the bidders to use either a conventional reinforced concrete design or prestressed concrete. All bidders based their estimates on a prestressed design.

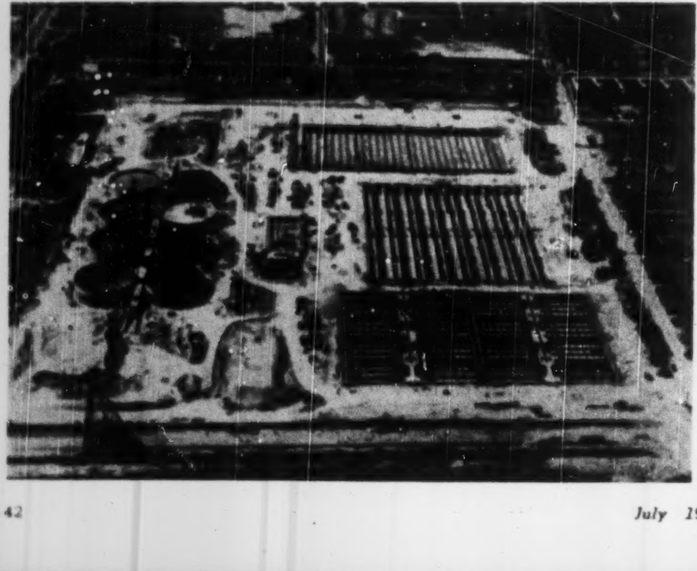
In constructing these tanks, a wall was first poured in steel forms, with the circumference divided into six segments. The wall thickness decreased from 14 in. at the bottom to 6 in. at the top. Vertical steel rods $^1/_4$ in. in diameter, anchored top and bottom in a chase, were prestressed by turning stud bolts. Then continuous steel wire under tension was wound around the outside of the wall by means of a traveling carriage.

The Northeast Works is designed for operation in four units. Sewage enters the primary tanks through an influent channel which provides 24 inlets to the tanks. Each of the four primary tanks is divided into seven channels with longitudinal and cross sludge collecting equipment in each tank. The total equipment consists of 28 longitudinal and 8 cross collectors, supported on concrete columns with their tops below the water line. Collector flights travel at 2 fpm.

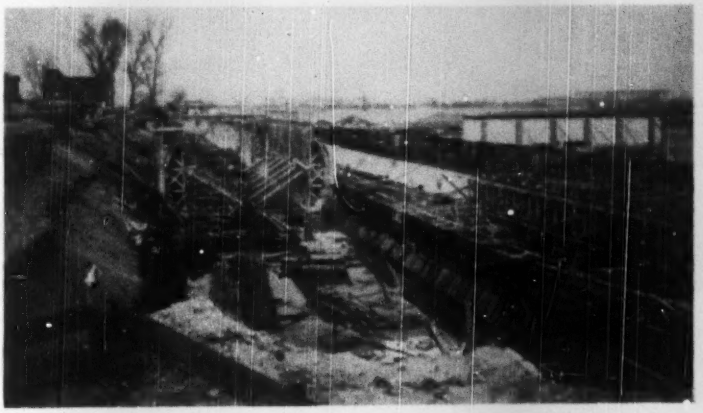
Aeration tanks are operated as four units, each of which is subdivided into four channels. Sewage enters the tanks over submerged weirs 5 ft long, two for each channel, and is discharged over similar weirs with a free flow. Principal air lines have been constructed in the alternate walls separating the channels. The air pipe is 18 in. in diameter at its largest dimension, decreasing to 8 in. Air reaches the sewage through swing diffusers, with diffuser tubes set 2 ft above the bottom of the tanks and connected to the main line by $3^1/_2$-in. wrought-iron laterals.

The final sedimentation tanks are also divided into four units, each with four individual tanks. Collectors in these tanks operate at 2 fpm. Sewage enters each tank through a 24-in. square gate and is distributed over the channel by redwood baffles.

The eight sludge digestion tanks are designed to operate as two batteries each with three primary tanks and one secondary tank. The primary tanks are designed for a working depth of 30 ft and the secondary tanks for 28 ft. All tanks have floating covers. Tanks and the pumping system are so interconnected that any



NORTHEAST WORKS, to treat 125-mgd of Philadelphia sewage, will be in operation this year. Aerial view shows construction under way on final sedimentation tanks in foreground and sludge digestion tanks at left.



FLOCCULATION channel 30 ft wide and 500 ft long is under construction for Southwest Station, now about half completed. Station will give primary treatment to 125 mgd of sewage.

pump can circulate the sludge in any tank and move it from any one tank to any other tank.

The blower building, built of buff brick trimmed with limestone, houses the air equipment, sludge heating equipment, return-sludge pumps and hot-sludge pumps. Air for the plant will be furnished by one centrifugal blower with a capacity of 16,000 cfm, two positive displacement blowers each with a capacity of 10,000 cfm, and one positive displacement blower with a capacity of 13,000 cfm, or a total blower capacity of 49,000 cfm.

Every effort has been made to ensure a clean supply of air to prevent clogging of the diffuser tubes. The interior wall of the blower building has been finished with glazed facing tile, with floors of quarry tile. Electrostatic air filters, with a total capacity of approximately 93,000 cfm, have been installed to remove dust. To further minimize dust and maintain satisfactory motor temperatures, a 60-ton air conditioning system has been installed to keep temperatures in the blower room at 65 deg F.

A new type of sludge heater, not known to have been previously used in sewage treatment works, has been installed from special designs developed by city and manufacturer's engineers. Sludge is pumped to one end of the seven sludge troughs, heated while passing through, discharged at the opposite end, and thence pumped to the digesters. Burners are made of stainless steel, lined with high-quality ceramic material, with water-cooled manifolds. Burners have a combustion capacity of 2,300,000 Btu per hour and are designed to burn sewage gas with a heat content of 650 to 750 Btu per cu ft.

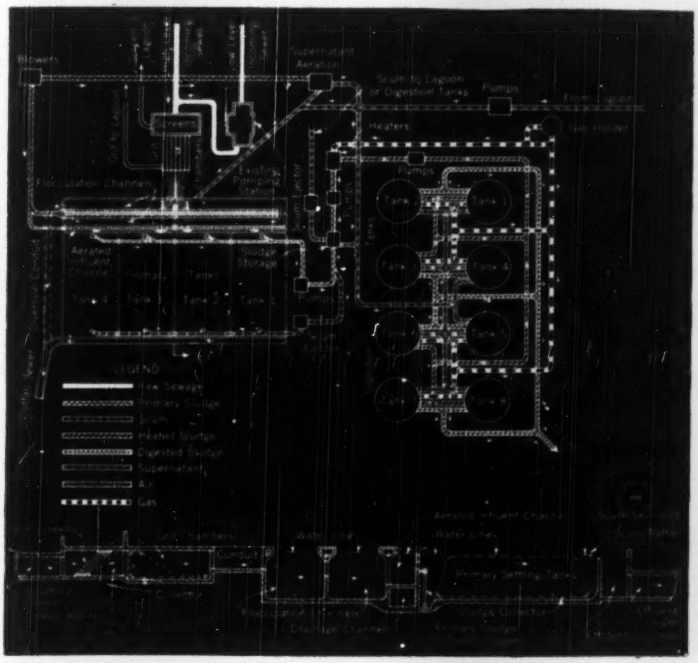
Sludge gas from the digesters is mixed with air and pumped to burners by turbo compressors. The hot products of combustion are liberated directly into the sludge through perforated stainless steel rectangular nozzles at temperatures of about 2,400 deg F. Most of this heat is entirely absorbed by the sludge. Measurement of exhaust-gas temperatures during tests ranged from 150 to 180 deg F. Tests also indicate an over-all thermal efficiency of 85 percent.

Primary sludge will be pumped to storage tanks, heated, and then pumped to the digestion tanks. It is planned to return about 16 percent of the activated sludge from the final tanks to the aeration tanks and to carry the rest back to the influent end of the primary tanks.

Gas from digestion tanks will be used to heat sludge and to heat the blower building. A spherical gas holder, with a capacity of 50,000 cu ft at 30-lb pressure, has been provided. Although a domestic gas manufacturing plant is located nearby, a study indicated that it would not be economical to screen and pump the excess gas to this plant.

To avoid any possible cross connection to the domestic water line which will be used for flushing and cleaning, a 50,000-gal water tank has been built. Operation of the new Northeast Works is planned to start about September 1, 1950. All major contracts are substantially complete.

In contrast with the early start of work on the Northeast Plant, the only prewar construction at the Southwest and Southeast Plants was



Blowers
Supernatant Aeration
Scum to Lagoon or Digestion Tanks
Pumps
From Lagoon
Screens
Grit Chambers
Heaters
Gas Holder
Pumps
Existing Pumping Station
Flocculation Channel
Scum Ejector
Pumps
Tank 2
Tank 1
Tank 3
Tank 4
Tank 6
Tank 5
Tank 7
Tank 8
Aerated Influent Channel
Primary
Tanks
Sludge Storage
Tank 4
Tank 3
Tank 2
Tank 1
Pumps
Overflow Conduit
LEGEND
Raw Sewage
Primary Sludge
Scum
Heated Sludge
Digested Sludge
Supernatant
Air
Gas
Grit Chambers
Conduit
Water Line
Aerated Influent Channel
Water Line
Primary Settling Tanks
Collector
Flocculation Channel
Discharge Channel
Sludge Collector
Primary Sludge

FIG. 4. SOUTHWEST PLANT, scheduled for completion in 1953, will digest its own sludge as well as that from Southeast plant in single-stage sedimentation operation. Digested sludge will be lagooned and supernatant liquor will be returned to plant.

CAISSON OF 73-ft diameter is sunk for pumping station on Central Schuylkill collector. Many interceptors in Philadelphia's current project are of large size and require tunnel construction of various types.

a small pumping station at the Southwest Works which has operated primarily to pump storm and ground water. As part of the over-all program for sewage treatment, the basic design for both of these plants has been completed. Construction work has started and will proceed as fast as contract drawings are finished.

Both the Southwest and Southeast Works will discharge their effluent into the Delaware River downstream from the main part of the city. At both points of discharge the stream has been classified by the Interstate Commission on the Delaware River Basin as in better condition than the reach along the central part of the city. This ruling has permitted a lesser degree of treatment at these plants. In each case, the treatment will consist of preflocculation, sedimentation and sludge digestion. The air used in the preflocculation tanks will be 0.03 cu ft per gal of sewage.

Because of the limited area and poor foundation conditions at the Southeast Works, the sludge digestion facilities for both plants will be constructed at the Southwest Works. Raw sludge will be pumped from the Southeast Plant through a pipeline about 4½ miles long, including the crossing under the Schuylkill River. The 800 acres of land available at the Southwest Works, and the general industrial character of the neighborhood, will permit the lagooning of sludge here for at least 20 years.

At the Southeast Works, construction started in August 1948 on the pumping station. This structure, 65 ft in diameter, will lift the incoming sewage 38 ft from the Lower Delaware collector. Contract plans for screens, grit chamber and sedimentation tanks are in preparation and bid invitations are scheduled for late this year. The sedimentation tanks are similar to those under construction at the Southwest Works and also to the primary tanks at the Northeast Works.

At the Southwest and Southeast Works the permit of the State Department of Health requires an effluent "equal to or better than that produced by efficient sedimentation." To meet this requirement without question, the initial installations will consist of preflocculation, sedimentation and two-stage sludge digestion. In both plants, however, the design contemplates future construction of aeration tanks and final sedimentation tanks if the future condition of the river requires this additional treatment.

Southwest Works Half Finished

Screens at the Southwest Plant will be of the straight bar type with 1-in. openings. Six grit chambers, 9 ft wide, 8 ft 6 in. deep, and 60 ft long will handle the incoming flow at the rate of 1 fps.

The flocculation tanks are built to retain sewage 30 min at the design capacity of 125 mgd. In these tanks, 500 ft long, 14 ft deep and 30 ft wide, air can be added at the rate of approximately 0.03 cu ft per gal. From the flocculation tanks, the sewage will flow through influent channels into the sedimentation tanks. The sedimentation tanks, built in four units, each 125 ft wide, 250 ft long, and 12 ft deep, are very similar to those used at the Northeast Plant. Sludge will be collected in the same way by 28 longitudinal and 7 cross scrapers.

Work on the flocculation and sedimentation tanks at the Southwest Works started in September 1949 and the contract is now more than 50 percent complete. No unusual construction problems have been encountered.

Construction of the eight sludge digestion tanks planned for the first installation at the Southwest Works is scheduled to start late this year. These tanks, all with floating covers, will be similar to those built at the Northeast Works. An area of 50 acres for lagooning sludge is available. Present plans call for the construction of four banks of lagoons totaling 500 ft wide, 2,000 ft long and 10 ft deep. It is planned to use the lagoon area as the second stage, returning supernatant liquor to the plant.

In all three plants, an effort has been made to reduce maintenance costs to a minimum by providing facilities that will have a long life and will resist corrosive action. In influent channels and primary tanks lumnite cement has been used in concrete above the water line to resist corrosion. Vitrified clay plates have been used above the water line at other locations, and free use has been made of aluminum in many parts of the plant, including buildings. Where possible, concrete which might be effected by sewage gas has been coated with bituminous material.

The intercepting system required to carry the sewage to the three treatment plants (Fig. 1) is an important part of the project, particularly in cost. Many of the interceptors are of large size and require tunnel construction varying from compressed air work along the rivers to rock tunnels through higher ground.

The intercepting system serving the Northeast Plant consists primarily of the Upper Delaware Collector extending northward from the plant to the city limits, and the Somerset Collector extending downstream to the limit of the treatment watershed.

The principal element in the intercepting system to serve the Southeast Works is the Lower Delaware Collector extending from the Southeast Works upstream a distance of five miles. The first section, about one mile long, 11 ft and 10 ft 6 in. in diameter, was completed at a cost of $410 per lin ft. Built near the river with an invert 32 ft below high tide, where borings indicated clay, sand and gravel at varying elevations, the specifications provided for construction in compressed air. Difficulty was experienced by the contractor at times in holding air in this tunnel. The tunnel was constructed using steel liner plates with a 15-in. plain concrete wall, placed as the tunnel progressed. No shield was used.

The principal unit in the collection system to serve the Southwest Works is the Southwest Main Sewer, a gravity line extending in a generally northern direction from the plant for five miles. At its lower end, this sewer acts as an inverted siphon for approximately 10,000 ft. The design was chosen because of the low elevation of the ground, and permitted construction on the surface, rather than above the surface. The rest of the system consists of circular sewers varying in size from 13 ft to 6

(*Continued on page 76*)

Engineers' Notebook

Quickly Constructed Model Facilitates Seepage Studies

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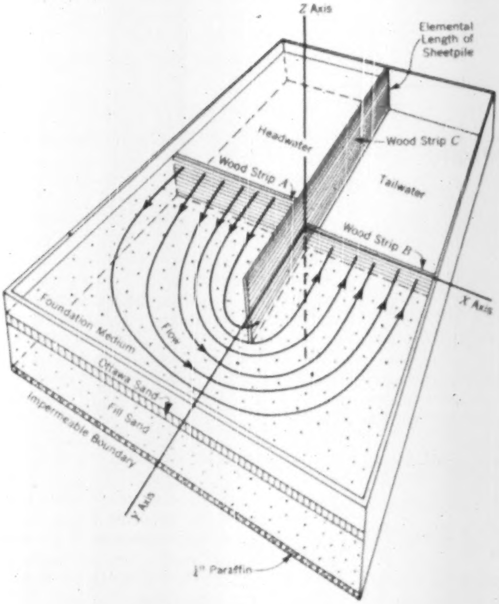
FUNDAMENTAL physical phenomena in a number of fields have been studied by setting up an analogue of the phenomena in a related field to show it in a more tangible form. For example, the migration of water through a porous medium such as a clean sand is analogous to the flow of heat and at the same time it is related to several problems encountered by the civil engineer. The initial step in solving such problems, the construction of the flow net, has proved difficult for students because they lacked an intuitive understanding of characteristic flow patterns. This understanding can be developed through a study of models which need not be elaborate or expensive. In fact the simpler models which can be built by the student himself have proved the most desirable.

FIG. 1. SEEPAGE MODEL, below, consists of baking pan 18 × 24 in. and 2 in. deep, with paraffin poured in bottom to hold wood strips which form watertight compartments. Two sand layers are placed over paraffin in near half of pan; and flow occurs through sand in plane of *X-Y* axes, whereas in conventional model, set up between two plates of glass stood on edge, flow occurs in plane of *X-Z* axes.

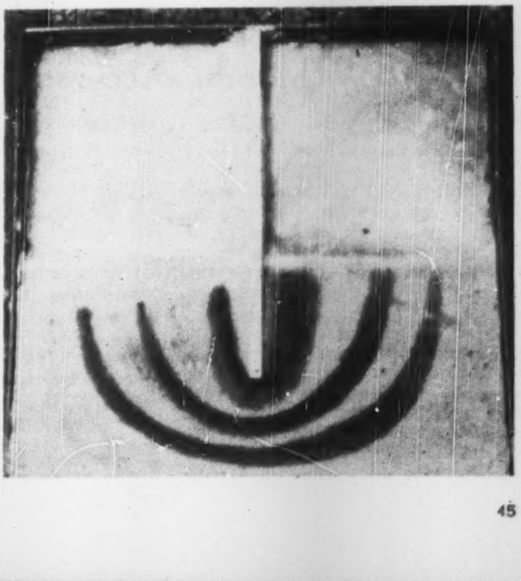


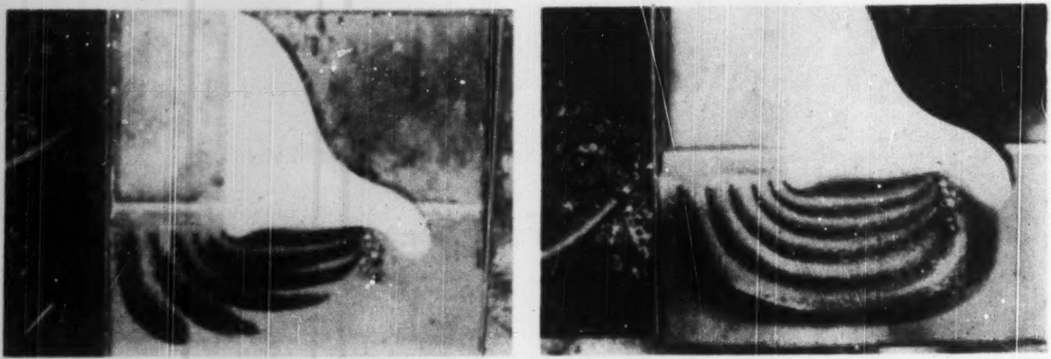
Difficulty with Old-Type Models

Models have frequently been constructed by placing two glass plates in a vertical position on each side of a typical cross section of the hydraulic structure and foundation medium to be studied. Such models are difficult to construct so that true boundary conditions are realized; therefore their use is limited. Some of these difficulties are avoided in the easily constructed devices described here, which can be built by a novice within an hour. They transfer the problem from the *X-Z* plane (vertical) to the *X-Y* plane (horizontal).

The simplest problem encountered in studying seepage is that of a sheetpile wall driven into a pervious foundation medium bounded on the bottom by an impervious boundary. In the *X-Y* plane model (Fig. 1) the equipotential line which is the upper surface of the pervious foundation medium is reproduced by the horizontal weir *A* upstream of the wall and by the similar wier *B* which is approximately $^1/_4$ in. lower and on the downstream side of the wall. The elevation head is constant for all points on the crest of wier *A*. This is true for all points on the crest of wier *B* but the elevation heads at *A* and *B*

SIMPLEST PROBLEM encountered in studying seepage is that of sheetpile wall driven into pervious foundation medium bounded on bottom by impervious boundary. Dye traces flow pattern in seepage model, below, built according to diagram in Fig. 1, left.





PROBLEM OF SPILLWAY SECTION on pervious foundation, with filter under down-stream toe, is set up for test in seepage model. Flow net, seen forming in photo at left, is complete in photo at right. Action of filter is demonstrated.

are not equal. This difference in head produces the flow through the sand; however, the gradient varies inversely as the distance from the cutoff barrier. The near edge of the pan in which the model is made corresponds to the top of the impervious stratum. With these boundary conditions established, the flow patterns traced in the surface of the fill by adding dyes to the water conform to those indicated by theoretical studies.

Materials for Model Easily Acquired

The materials required for the construction of the model shown in Fig. 1 are: one baking pan 18 × 24 and 2 in. deep; 2 lb of paraffin; assorted food colors; ottawa sand (for use as a covering for the fill); three small strips of wood, "A" ($^1/_2 \times 1 \times 11^3/_4$ in.), "B" ($^1/_2 \times {}^3/_4 \times 11^3/_4$ in.), and "C" ($^1/_2 \times 2 \times 13^1/_2$ in.).

First, melted paraffin is poured into the bottom of the pan to a depth of $^3/_4$ in. and in it are embedded the three pieces of wood "A," "B" and "C," as shown in Fig. 1, to form three watertight compartments. The crests of the two wiers should be made horizontal and checked with a spirit level. The part of the model simulating the foundation medium is covered with fill sand to the crest of the wiers. Ottawa sand is then spread over the fill sand to a depth of $^1/_4$ in. It is very pervious, but because of the small hydraulic gradients, offers sufficient resistance so that laminar flow prevails.

Several food colors are introduced at intervals along the crest of the upstream weir, and are carried by the seeping water as it progresses downstream, to form a definite flow pattern, as shown in the photograph on the preceding page.

This device can also be used to show the effects of various seepage control measures. For example, two of the accompanying photographs (at top of this page) show a model constructed to study the interception of seepage by a vertical filter under an overflow structure.

If this device finds favor with investigators, many other applications will result. It is hoped that such developments will be published so that they can be widely applied.

Linear-Scale Slide Rules Provide Uniform Accuracy

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LINEAR-SCALE slide rules are characterized by evenly spaced scale divisions in contrast with the usual type of slide rule utilizing logarithmic scales. Linear slide rules have the advantages of constant accuracy throughout the scale, easy construction with simple drawing instruments if desired, low manufacturing cost, scale reading facility, and simple construction of scales. Operations that can be performed include multiplication and division; combinations of addition, subtraction, multiplication, and division; and evaluation of reciprocals. Scales for obtaining natural trigonometric functions and for polar-rectangular coordinate conversion ($Re^{j\theta} = a + jb$), can be added without recourse to mathematical tables, computation, or special construction tools.

The design theory of one form of linear slide rule is based on the unit circle, Fig. 1.

Division and Multiplication by Linear-Scale Slide Rule

These relationships suggest a practicable device for solving the operations of division ($T = S/C$) and multiplication ($S = TC$). By constructing a mechanical representation of the S, T, and C scales in proper position, and mechanically setting any two terms of the expression, $T = S/C$, to conform with given arbitrary values, the third term can be obtained. A simple linear slide rule derived from these relationships is shown in Fig. 2. When indicator M falls above the T scale for any particular setting, a $T2$ scale is used to obtain the correct reading, as shown in Fig. 3.

Reciprocals can be obtained by the process of division in the expression $T = S/C$, where $S = 1$ and C is equal to the number for which the reciprocal is to be computed. For this purpose it is convenient to use an additional scale, R, in Fig. 4, which is a projection of the C scale 10 divisions higher up.

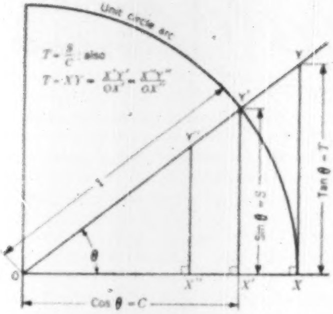
Unit Circle arc
T = S/C; also
T = XY = X'Y'/OX' = X''Y''/OX''
Y
Y'
Y''
1
θ
O
X''
X'
X
Sin θ = S
Tan θ = T
Cos θ = C

FIG. 1. **UNIT CIRCLE** shows relationship between trigonometric functions and is basis for linear-scale slide rules.

Trigonometric functions are obtained directly by the use of two indicators, M and S, as shown in Fig. 5.

Electrical Linear-Scale Slide Rule

The principle of proportionality as expressed by $T/1 = S/C$ can also be extended for computation electrically, as shown in Fig. 6, where T, P, S, and C are calibrated variable resistances arranged in a bridge circuit. The circuit parameters are set to suit the expression, $T = S/C$, and a solution is reached by the following procedure. For example, to solve for T where $S = 5$ and $C = 4$, set the calibrated dials of the bridge arms as follows: $S = 5$, $C = 4$, and $P = 1$. Rotate the calibrated dial of arm T until the galvanometer reads zero. The T dial reading, 1.25, is the quotient of S/C. The dials may be calibrated so that they can be read directly.

Combined Multiplication and Division

Manipulation of the expression of proportionality will increase the utility of this slide rule. If arm P is set at a value other than unity, the device will solve combined multiplication and division ($T = PS/C$).

It will also solve square roots. Since $T/P = S/C$, then $T = PS/C$. If $P = S$ and $C = 1$, then $T = SS$ and $\sqrt{T} = S$. Therefore set the dials as follows: T = the given number, and $C = 1$. Vary P and S simultaneously so that the P and S dials read the same at all times. When the galvanometer reads zero, $\sqrt{T}$ is read as desired on the S or P dial. For convenience, S and P may be coupled together so that only one control is necessary for solutions of this sort.

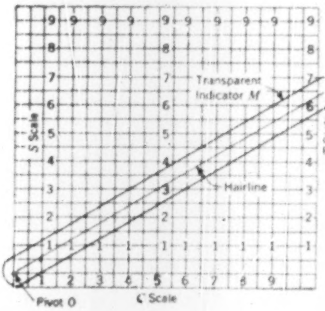
S Scale
T Scale
Transparent Indicator M
Hairline
Pivot O
C Scale
1
2
3
4
5
6
7
8
9

FIG. 2. **SIMPLE** linear-scale slide rule, derived from relationships shown in Fig. 1, is set for division of 30/5 = 6. Tangent scale is marked T, cosine scale C, and sine scale S.

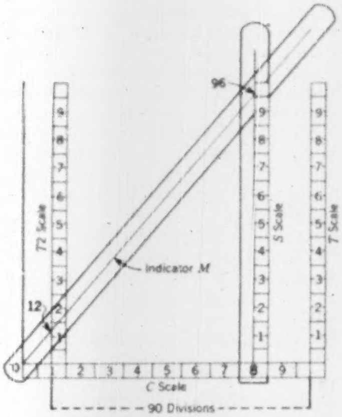
96
12
T2 Scale
S Scale
T Scale
Indicator M
C Scale
90 Divisions
0
1
2
3
4
5
6
7
8
9

FIG. 3. **AUTOMATIC INDEX SHIFTING** permits reading to be made when point on indicator M falls above top of T scale. Correct reading is then obtained from intersection of indicator M with $T2$ scale located 90 divisions to left of T scale. $T2$ scale is equivalent to T scale extended 10 times in range. Length of unit division of $T2$ scale is one-tenth that of T scale.

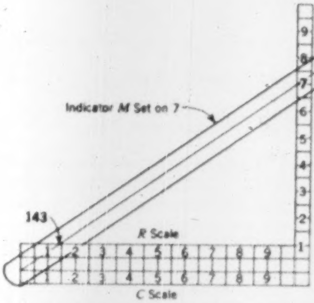
Indicator M Set on 7
143
R Scale
T Scale
C Scale
1
2
3
4
5
6
7
8
9

FIG. 4. **RECIPROCAL** is obtained by use of R scale, projection of C scale ten divisions higher up. To obtain reciprocal of 7, for instance, set indicator M at 7 on T scale and read 0.143 on R scale.

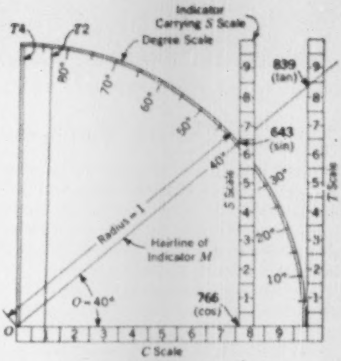
Indicator Carrying S Scale
T4
T2
Degree Scale
90°
80°
70°
60°
50°
40°
30°
20°
10°
839 (tan)
643 (sin)
766 (cos)
S Scale
T Scale
Radius = 1
Hairline of Indicator M
θ = 40°
O
C Scale
1
2
3
4
5
6
7
8
9

FIG. 5. **TRIGONOMETRIC FUNCTIONS** are obtained by means of indicators M and S, here set for angle of 40 deg. Indicator M is first set at 40 deg on degree scale, then indicator S at intersection of indicator M and this scale. Sine function 0.643 is read on S scale at its intersection with degree scale; cosine function 0.766, on C scale at its intersection with indicator S; and tangent function 0.839, on T scale at its intersection with indicator M.

A Slide Rule for the Blind

An electrical slide rule can also be constructed for the blind by modifying the circuit shown in Fig. 6. A low-frequency a-c source is used instead of the battery E, and a pair of headphones (or a loudspeaker) in place of the galvanometer G. The dials are calibrated in Braille lettering. The operator listens for a lull while balancing the circuit and then reads the Braille identification on the T scale for the solution of the problem.

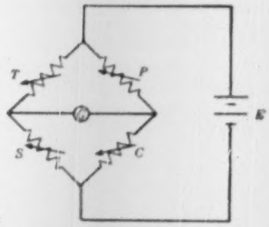

FIG. 6. **ELECTRICAL** linear-scale slide rule is constructed by arranging calibrated variable resistances T, P, S, and C in bridge circuit. Arm P is set so that when bridge is balanced, $T/1 = S/C$. E is source of electrical potential and G is galvanometer. Linear slide rule for the blind can be made by substituting low-frequency a-c source for E, and pair of headphones for galvanometer G.

[illegible] Write

Do Climatic Variations Follow Definite Cycles?

To the Editor: The article, "Cyclic Variations in Columbia River Flow Studied," by G. N. Person in the April issue, brings up again the basic question as to whether or not identifiable cycles exist in non-seasonable, long-time climate.

Various investigators, on the basis of hydrologic and meteorological data, annual tree rings, sunspots, geological records found in rock beds, glacial formations and varved strata, have proposed a great number of cycles. To my knowledge, more than 140 climatic cycles have been proposed, with lengths ranging from very short periods up to 5,427 years. The investigators' conclusions have been far from unanimous.

Mathematically speaking, any given series of observations, including random ones, can be resolved into a system of harmonics of different periods and amplitudes by a Fourier series of a sufficient number of terms, but the chief difference between true cyclic and random variations lies in the fact that in the former case all the harmonics, or a substantial part of them, persist in such a way that exact or approximate predictions of future occurrences can be made. Unfortunately, many proposed climatic cycles have failed to meet this criterion. Many other cycles have held for a time and then the record line has gone off so that the cycle can no longer be traced.

As for sunspot activities, some meteorologists and hydrologists have claimed that there can be no clearly demonstrable connection between sunspots and precipitation, and hence runoff, and if there is any such connection it is obscured and possibly completely offset by intervening atmospheric activities.

In a study of drought, J. C. Hoyt indicated that "Studies of tree rings have been carried back for centuries in some regions without definitely revealing a repeating cycle." ("National Aspects of the Drought," Civil Engineering, Vol. 1, p. 1167, 1931). In an article on "Study of Weather Records Fails to Reveal Long-Range Cycles" (*Engineering News-Record*, Vol. 113, p. 46, 1934) J. B. Kincer has made comparisons of records at scattered stations for cycles of 11, 23 and 35 years, indicating that a long-range forecast based on climatic cycles would have been wrong about half the time.

Since the word "cycle" is generally taken to mean a regular recurrence, with time intervals of equal length, it is questionable whether this term is the proper one to describe climatic variations. Dr. Ellsworth Huntington, who made the well-known measurements of California sequoia rings, has used a better term, "pulse," to represent these phenomena in his famous book, *Civilization and Climate* (Yale University Press, 1924).

It is believed that further study as well as an accumulation of new evidence is needed on this subject of climatic cycles, to which Mr. Person's article is a valuable contribution.

Ven Te Chow
Hydraulic Engineering Laboratory
Urbana, Ill.

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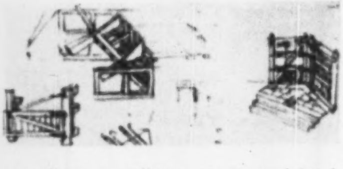
Radial-Type Gate Found in Leonardo's Sketchbook

To the Editor: The article by Mr. Streiff in the March 1950 issue contains an interesting historical account of the development of the Tainter gate. According to the author, this type of gate originated in France nearly a century ago.

It is of further interest to note that illustrated in a short article in German by C. Reindl (*Wasserkraft und Wasserwirtshaft*, May 15, 1940, Vol. 35, p. 116), is



a small "segment" type, counterweighted lock gate which appears to be a creditable version of our Tainter type. This illustration is a reproduction from the sketch books of the amazing Leonardo Da Vinci (1452–1519).

C. E. Kindsvater, M. ASCE
Professor of Civil Engineering,
Georgia Inst. of Technology
Iowa City, Iowa *(on leave)*

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Existence of Cycles in River Flow Denied

To the Editor: It would seem from reading Mr. Person's article, "Cyclic Variations in Columbia River Flow Studied," in the April issue, that hydrologists and engineers need only determine a few more cycles and the annual flow of the Columbia River will be known for years in the future. Unfortunately this is not true. If the Columbia River flow consistently followed cycles of any sort, it would be a relatively simple matter to perform a harmonic analysis on the past annual flows, assuming an initial period equal to the length of record and using deviations from some mean value or trend line. However, because rivers do not follow cyclic laws, statistically reproducing past flow records and extrapolating them into the future invariably fails to yield correct flows.

The annual flow of a river is a function of complex meteorological and hydrologic conditions existing in time and space over the drainage basin. The proper evaluation of these conditions in terms of parameters that may be useful in forecasting annual stream flow is a continuing project in which the Weather Bureau, Bureau of Reclamation, and Corps of Engineers have taken the lead. Only through such lines of endeavor, including detailed studies of rainfall records, temperature sequences, and snow conditions in the basin, can we hope eventually to ascertain the flow of the Columbia River in the years ahead.

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University of California
Berkeley, Calif.

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Structure Strain Rate Differs from Test Rate

To the Editor: Homer M. Hadley's article in the April issue, "When Concrete Becomes Discrete," is interesting in describing the behavior of concrete at strains exceeding that corresponding to its ultimate stress in compression. However, the "new theories of concrete in flexure" referred to are not based on this past-ultimate range, because this range has little significance for an actual structure.

The mechanism of the usual testing machine applies *strains* to a concrete cylinder at an arbitrary rate and measures the cylinder's resistance to these strains. In the actual structure, on the other hand, a load (not a strain) is applied to a compression member, and (in a non-redundant structure) change of strain does not influence this load. Therefore, if this load is increased up to the ultimate, the increased strain rate accompanying this ultimate point will not reduce the load, as it would in a test specimen, and failure follows almost immediately. The stress-strain curve describing this process will be like curve X, which naturally would be most difficult to reproduce with a testing machine.

The new theories of flexure are actually based on the action of concrete under stresses less than the ultimate. These stresses applied for hours or even years to an actual structure cause a plastic flow which of course does not show up in these tests of six minutes' duration. Also, this plastic flow is not accompanied by the fragmentation pictured in the article for these short-term tests.

Another important point is that the enlargement of diameter of a compression specimen is *not* accompanied by tangential tension. The strain given by Poisson's ratio does not cause a stress in the same direction, unless this strain is partially prevented by, for example, the spirals of a concrete column, or friction between test specimen and head of the testing machine. This fact, that stresses in two dimensions are not proportional to corresponding strains, is of great importance to all experimental workers who attempt to obtain stress by measuring strains.

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Assoc. M. ASCE
Asst. Prof. of Civil Engineering,
University of Alabama

University, Ala.

Reinforced Concrete Panel Shows Plastic Action Under Test

To the Editor: In his paper, "When Concrete Becomes Discrete," in the April issue, Homer M. Hadley presents a set of carefully conducted tests on plain concrete cylinders, which establish rather conclusively that such cylinders under uniaxial compression and relatively rapid loading fail by fragmentation. From these tests one might draw the implication that plasticity would not occur in significant amounts in concrete structures—a totally incorrect conclusion. The distinction between the concrete test cylinder and the concrete structure is inherent on two counts: (1) stresses in the built-up structure are multiaxial, (2) the structure is almost invariably reinforced with steel rods.

With multiaxial stresses fragmentation may be restricted. In the extreme case of equal triaxial compressions, fragmentation would be restricted by the simple physical limitation upon space for separation of fragments. From the viewpoint of the stress analyst, failure of a test cylinder starts with shear slip, and shearing stresses will be greatly reduced by the addition of multiaxial compressions.

The greatest difference, however, between the flow characteristics of the cylinder and the structure lies in the tensile resistance provided by reinforcing rods. Rods embedded in concrete show about the same characteristics of plastic flow as those tested in direct stress in a testing machine. In other words, plastic extensions at the yield stress may be expected to reach from 10 to 20 times the elastic strain.

It might be thought that this extreme extension of reinforcing rods for flexural members could not be attained in reinforced concrete without permitting the fragmentation observed in cylinder tests. Actually, tests show that this is not true (Figs. 1 and 2).

It is clear from Fig. 2 that the reinforced concrete slab after severe overloading, which produced a permanent deformation of 1.3 in., still functioned elastically (full elastic recovery) for a repetition of a *normal test loading* equivalent to $1\frac{1}{2}$ times the live load plus one-half the dead load. Evidently then, no fragmentation of the compressive concrete could have occurred and none was visible upon inspection.

It seems reasonable to conclude that the plastic deformation due to a superimposed loading of 3.7 times the design live loading producing total deflections of 15 times the normal elastic live-load deflections can be anticipated in similar construction. Such a degree of plasticity is more than enough to provide the moment or stress redistribution that is needed in design based upon ultimate load capacity.

It is the writer's opinion that the accumulation of experience, experiments and theoretical study is leading inevitably toward collapse load as the logical basis for setting a factor of safety. Of course, much more research will be needed before this process crystalizes into an acceptable specification either for steel or reinforced concrete design. Plain concrete is at best a relatively brittle material. To the extent that the author's tests were intended to question the assumption of plasticity in non-reinforced structures, he is on relatively firm ground.

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Chicago, Ill.

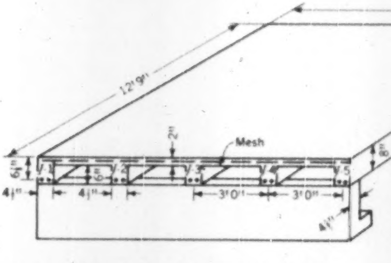

FIG. 1. T-BEAM FLOOR PANEL (ABOVE) of slab-and-joist construction developed compressive strength of 5,860 psi at 54 days. Steel bars showed elastic limit of 44,500 psi and ultimate strength of 78,000 psi with elongation of 25 percent before fracture. Panel was designed for live load of 50 psf and calculated dead load was 35 psf. Hence superimposed test load, being 1.5 times live load plus dead load, was 92.5 psf. From "Long-Time Overload Tests of a T-Beam Floor Panel," L. E. Grinter and Burge Kepford, *Proceedings of American Concrete Institute,* February 1941, pp. 433–438.

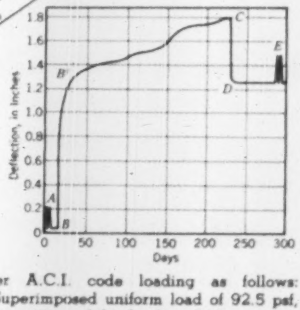

FIG. 2. CURVE (RIGHT) shows cumulative deflection for center joist of Fig. 1 panel under A.C.I. code loading as follows: (1) Superimposed uniform load of 92.5 psf, and repetition of this loading 24 hours after its removal (see point *A*); (2) double loading of 185 psf left in place for six months, then removed and recovery permitted (see curve *BB'CD*); (3) repetition of loading of 92.5 psf, removal of this loading for 24 hours, and another repetition of loading of 92.5 psf (see point *E*).

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What Stresses Occur in Concrete Test Cylinders?

To the Editor: In the article, "When Concrete Becomes Discrete," by Homer M. Hadley, in the April issue, a statement appears that should not go unchallenged. Referring to the lateral expansion of a material axially loaded in compression, Mr. Hadley says, "This enlargement of the diameter can only occur with an accompanying tangential tension."

Consider a ring-shaped element of radius r and thickness dr, r being measured from the axis of symmetry. The length of the element is then $2\pi r$. When the axial compressive stress on the material inside the ring is increased by some amount S, r is increased by an amount, $\Delta r = \frac{mrS}{E}$

where m is Poisson's ratio and E is the modulus of elasticity. The ring-shaped element is therefore increased in length by

$$\Delta_1 = \frac{2\pi m r S}{E}$$

If the ring-shaped element were not itself subjected to axial compression, this increase in length would be resisted by a tangential tension. Because of the axial compression which all such elements in a simple compression test sustain, the element expands laterally (without lateral stress) so that the length of the element is increased by

$$\Delta_2 = \frac{2\pi m r S}{E}$$

The strain causing stress is $\Delta_1 - \Delta_2$, which in this case is evidently zero. The quoted statement therefore appears in error, if I have not mistaken its meaning.

The true reasons for the formation of vertical cracks in axial compression tests of quasi-isotropic materials have been discussed by Richart, Brandtzaeg, and Brown,[1] Griggs,[2] and Terzaghi.[3] In such a material, tensile stresses may be induced in almost any direction as a result of its heterogeneity, and possibly it was this to which Mr. Hadley referred.

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Instructor in Theoretical
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Urbana, Ill. *University of Illinois*

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[1] F. E. Richart, A. Brandtzaeg, and R. L. Brown, "A Study of the Failure of Concrete under Combined Compressive Stresses," Bulletin No. 185, Engineering Experiment Station, University of Illinois, Urbana (1928).

[2] D. T. Griggs, "Deformation of Rocks under High Confining Pressures," *Journal of Geology*, vol. 44, p. 544 (1936).

[3] K. Terzaghi, "Stress Conditions for the Failure of Saturated Concrete and Rock," *Proceedings*, American Society for Testing Materials, vol. 45, p. 777 (1945).

Line Drawn Between "Business" and "Profession"

To the Editor: The article, "Is Engineering a Profession or a Business?" by Donald M. Baker in the March issue, is particularly timely in view of the recent action of the State Corporation Commission of the Commonwealth of Virginia. It is reported that this body in an informal opinion considers engineering to be a profession. On this premise charters to corporations to engage in engineering will no longer be granted.

This statement is worthy of serious consideration by all concerned. The difference between a business and a profession for an organization is essentially the same as for an individual. The prime motive of the "business" man is to make a profit. The distinguishing characteristic of the "professional" man is in the use of his abilities in a specialized field to be of service while receiving compensation commensurate with his experience and his investment in education and training.

The conduct of a business is not limited by any restrictions other than those prescribed by law. A profession is governed by the ethics established by the profession involved. The services bought from a purely "business" standpoint cannot be of as high quality as those based on accredited technical skill with the added incentive of a high ethical regard for the buyer's interests.

In many cases the majority of personnel of engineering (business) organizations are not professional men, but are technicians without the professional attitude, and as such are a ripe field for unionization propaganda. Young graduate engineers in routine jobs are often confused by this prospect.

I have known of instances of "business" men securing an engineering commission and hiring a licensed professional engineer for a short period to secure his seal for the filing of plans and then dispensing with his services. Such a state of affairs weakens the status of the employed "professional" and the engineering profession as a whole. Qualified engineers should secure professional licenses, and engineering societies should support a movement to see that more principals of engineering organizations qualify for license and not merely do "business" with a few accredited professional employees in their organization to give their projects a professional aspect.

Let it be made definitely clear to the buyer or client whether or not he is dealing with a business or professional organization, and let the limits of activity be more clearly established and defined.

Eric Fleming, M. ASCE
Architect and Engineer
New Brunswick, N.J.

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Engineering Is a Profession

To the Editor: In the March issue, Mr. Baker asks, "Is the Practice of Engineering a Profession or a Business?" His point is well taken and, as he states, is deserving of the best thinking the engineering fraternity can produce.

The practice of professional engineering on any large scale is definitely a "business," and any large office should, and usually does, employ the very best methods of business administration. Departmentalization and the establishment of a line of authority is mandatory for efficient and coordinated operation.

It is true that the increasing magnitude of the projects handled, plus the incredibly short time schedules established for completion, have inevitably led to "team" type organization. Notwithstanding such integration and specialization, there is a personal relationship between the professional engineering "practitioner" and the client which is peculiar to engineering.

Society (the state), in the exercise of its police power for the safeguarding of life, health and property, has set up laws to regulate the practice of engineering and architecture. The basis of these laws is individual competency. Herein lies the similarity with the legal and medical professions. No such condition is imposed on the banker, the insurance executive or the industrialist.

It follows, therefore, that even when engineers are organized as a corporate entity for practical "business" reasons, the principal officers and all those in responsible charge of work have been examined and registered by an authority established by law. On this premise society must and does acknowledge the "professional" status of each registered individual apart from the corporate entity. Moreover, the law imposes upon the engineering graduate a statutory waiting period, similar to internship, before he is admitted to professional examination.

If we as engineers desire to achieve professional status in the public mind, we must be constantly alert, within ourselves and within the field of our endeavors, to rules of conduct commensurate with that status. The public will not withold its judgment if we demonstrate an understanding of our responsibilities to our fellow men and our willingness to accept regulation and control to insure that society's interest is always served first.

B. P. Harrison, *Giffels &*
Vallet, Inc. and L. Rossetti,
Associated Engineers and
Detroit, Mich. *Architects*

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Engineering Held Both a Profession and a Business

To the Editor: The answer to Donald M. Baker's question, on page 39 of the March issue, is so simple that Mr. Baker seems to have overlooked it. The answer is, of course: "The practice of engineering is both a profession and a business."

What seems to bother Mr. Baker is the fact that the professional services of engineers are made available today through large organizations rather than through man-to-man contact. The practice is just as professional if a client goes into a large office and buys this service as it is if he goes into a one-man office and buys it. Not only that but the owner of a one-man office is probably more in business than the employee in a large

(*Continued on page 73*)

SOCIETY NEWS

For Proceedings Abstracts and Order Blank, See Pages 97 and 98

Gail A. Hathaway Is Nominated for ASCE President

Gail A. Hathaway, Special Assistant to the Chief of Engineers, Department of the Army, Washington, D.C., has been nominated for 1951 President of the Society by the ASCE Board of Direction. Mr. Hathaway, an internationally known hydraulic engineering specialist in the field of water resource development, has been a member of the Society since 1934, and has served it with distinction in posts of increasing importance. After several years of active participation in Local Section affairs, Mr. Hathaway was chosen president of the District of Columbia Section in 1942, was elected ASCE Director from District 5 in 1944 and Vice-President from Zone II in 1946. He has served on many national committees of the Society, including the Committee on Employment Conditions, the Committee on Salaries, the Centennial Planning Committee, the Committee on Inter-Society Cooperation, the Committee on Hydrology, and the Joint Committee on Snow, Ice and Permafrost.

On his graduation from Oregon State College in 1922—following an interruption for service in World War I—Mr. Hathaway engaged in dam and canal surveys and irrigation construction work in Oregon. He became assistant to the Oregon State Engineer in 1924, and four years later joined the Corps of Engineers as hydraulic engineer in the Kansas City District Office. Promoted to the Missouri River Division Office in 1934, Mr. Hathaway was engaged on the hydraulic design of Fort Peck Dam in Montana, largest hydraulic earth-fill dam in the world, and was consultant on hydraulic design studies for other major Corps of Engineers' civil works projects.

GAIL A. HATHAWAY
Nominee for President, 1951

Called to Washington in 1937 to serve in the Engineering Division of the Office of the Chief of Engineers, Mr. Hathaway was made Special Assistant to the Chief of Engineers in 1945. In this capacity, he serves as a technical adviser to the Chief of Engineers on policy and engineering matters related to the civil works and military programs of the Corps of Engineers. The civil works program of federal works for the improvement and control of the nation's water resources in the interest of flood control, navigation and allied purposes has become the nation's largest single public-works program.

Mr. Hathaway's professional interests have extended far beyond those of his immediate work. His talents and experience have been sought for many special purposes, and the Corps of Engineers has cooperated in making his services available for a variety of responsible assignments. In late 1944, he undertook a mission as special adviser to the Chief Engineer, European Theater of Operations, in connection with the organization and operation of the Rhine River Flood Prediction Service. For services rendered on this important mission for the Allied Armies, he received a Presidential Citation and the Bronze Star Medal. In 1946 he was engineering consultant to President Truman's Cabinet Committee on Palestine during meetings held in London. On that mission, he investigated and reported on potential water resource development in Palestine and adjoining countries of the Middle East. In 1947 he was engineering consultant to the Venezuelan Government on flood control and water resource development. From 1947 to 1949 he was a member of the Inter-Departmental Committee, United Nations Scientific Conference on Natural Resources, and he is the present chairman of the United States Committee of the International Commission on Large Dams, World Power Conference.

Mr. Hathaway holds membership in the Washington Society of Engineers, of which he was a director in 1947–1948; the American Meteorological Society, serving as president of the Washington Branch in 1941; the American Geophysical Union; the International Union of Geodesy and Geophysics; the National Research Council; the Society of American Military Engineers, and Sigma Tau. He is the author of more than 20 technical papers, including reports and sections of handbooks pertaining principally to flood control and water resource development.

Extensive Program Is Arranged for Toronto Meeting

The Joint Summer Convention of ASCE with the Engineering Institute of Canada in Toronto, July 12–14, will give members an unexcelled opportunity to further acquaintance with engineers from neighboring countries, and at the same time study at first hand the mutual engineering problems and accomplishments of the two groups. The 21 scheduled sessions offer wide engineering coverage, as indicated in the full program printed in the June issue of Civil Engineering.

Most of the convention activities, including the technical sessions, will be held at the Hotel Royal York, in downtown Toronto. However, a special conference, planned by the Hydraulics Division, will be held in the splendidly equipped new hydraulics laboratories at the University of Toronto. The sessions are scheduled for Thursday and Friday of the convention week, permitting participation in other convention activities. The hydraulics conference will highlight

TORONTO SKYLINE, SHOWING EXTENSIVE BUSINESS AND INDUSTRIAL AREA, rises in background of far-flung and beautiful lakefront. More than 4,000,000 tons of cargo pass annually through city's $40,000,000 harbor facilities. Photo courtesy Canadian Pacific Ry.

discussion of model and prototype studies.

Outstanding Speakers to Be Heard

ASCE President Ernest E. Howard will deliver the annual Presidential address at the morning session opening the convention. "More Effective Utilization of Water Resources" will be the subject of a timely address by Past-President W. W. Horner at the Joint Membership Luncheon on July 12. Mr. Horner is chairman of the EJC Committee on National Water Policy. The stake of engineers in the economic health of society will be the subject of the principal address at the Joint Membership Banquet on Wednesday evening. Dr. Alfred P. Haake, consulting economist to General Motors Corporation, will be the speaker.

At a Joint Membership Luncheon on July 14, Lt. Col. Lyndal Urwick, London industrial consultant, will describe "Management Developments in Britain." The featured speaker at the annual banquet of the Engineering Institute of Canada on Friday will be the Hon. Lester B. Pearson, Secretary of State for Canada.

Sightseeing Tours Offered

Numerous opportunities are offered for sightseeing both in the city of Toronto and in the surrounding area. A full afternoon is given over to a trip to Niagara Falls, and several shorter excursions are scheduled. Many engineers are planning to combine attendance at the convention with a vacation tour of the Canadian provinces.

Sections Study Local Problems in Regional Conferences

WIDE COVERAGE WAS given Local Section and professional problems in two recent week-end conferences of Sections in opposite parts of the country that had the primary objective of bringing ASCE to the local level. On the same week end, the Tacoma Section was host to the second annual meeting of the Pacific Northwest Conference in Tacoma, Wash., and the Georgia Section to the second Eastern Regional Conference, consisting of Sections in District 10, in Atlanta.

Pacific Northwest Conference

A proposal for improving the position of engineers, submitted by the Seattle Section, was the subject of much discussion at the Pacific Northwest Conference. In a report of the Seattle Section's Committee on Review of the Code of Ethics, C. C. Arnold and Leland Sphar, Seattle consultants, reported the unanimous opinion of the committee that the ASCE Code of Ethics needs no revision and that, together with our Code of Practice, it forms a thoroughly sound basis for relationships between engineer and client and between engineer and engineer.

They also outlined a plan developed by the committee for organization of the various engineering groups in an attempt to attain the economic and professional status consistent with their professional responsibilities. Specific objectives of the proposed program, which makes nine recommendations, include publicizing the work of the engineer by ethical means, raising standards of professional remuneration, and work with bargaining groups recognized by ASCE.

Commenting on the report, Mr. Arnold stated that "the economic plight of the engineer is due directly to the failure of the engineer to properly sell his profession." Mr. Sphar urged that the Pacific Northwest Conference support the program, and said that its success will hinge on Local Section cooperation. He asked also for the interest and support of the other Founder Societies.

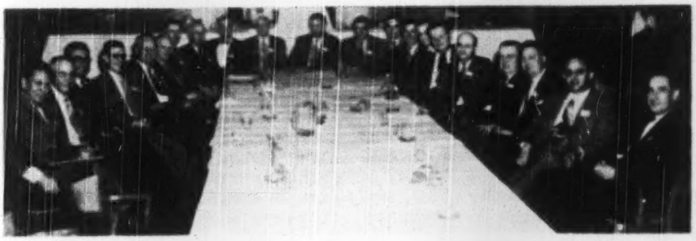
Other speakers included ASCE Director Walter Ryan, who reviewed the Los Angeles Meeting; President Ernest E. Howard, who spoke on "The Profession and the Society" at a joint luncheon with the ladies; Guy Taylor, of Portland, Ore., whose topic was "Education of the Engineer;" and John W. Cunningham, Portland consultant, and Edward C. Dohm, secretary of the Washington State Professional Licensing Board, who outlined the development of professional engineering registration laws. A Saturday morning panel discussion on design and construction features of the second Tacoma Narrows Bridge was led by Charles E. Andrew, principal engineer for the Washington Toll Bridge Authority. A field trip to the construction site, made possible by the Bethlehem Pacific Coast Steel Corp., supplemented the panel discussion.

CHAIRMAN-ELECT of Pacific Northwest Conference, Prof. Thomas H. Campbell (left) congratulates John L. Stackhouse, retiring chairman, on success of two-day meeting in Tacoma, Wash.

John Stackhouse was conference president. Officers for next year's conference are Thomas H. Campbell, chairman; Guy H. Taylor, vice-chairman; and R. O. Sylvester, secretary-treasurer.

District 10 Conference

J. M. Roberts, of Atlanta, was chairman of the second annual meeting of the District 10 Conference, which took further steps toward organization of a permanent conference by study of a proposed constitution. The highlights of last year's conference were reviewed by Ernest M. Titus, of the Tennessee Valley



DISTRICT 10 DELEGATES attending Local Section Eastern Regional Conference in Atlanta are, left to right, Warren S. Mann, Georgia; Thomas H. Winchester, Georgia; M. B. Nixon, Georgia; H. J. Spaeder, Georgia; Van P. Enloe, Georgia; F. J. Lewis, Nashville, Tenn.; H. B. Aikin, Knoxville, Tenn.; Edmund Friedman, Miami, Fla.; C. W. Okey, Tennessee Valley; Ernest M. Titus, Tennessee Valley; J. M. Roberts, Georgia; C. M. Mower, Georgia; T. B. Lee, Nashville, Tenn.; W. C. Sensing, Nashville, Tenn.; J. C. Voorhees, Tennessee Valley; W. F. Moehlman, Tennessee Valley; D. H. Mattern, Tennessee Valley; B. W. Davis, North Carolina; E. B. Rice, North Carolina; A. E. Johnson, South Carolina; and F. T. Thompson, Tennessee Valley.

Section, who affirmed the aim of the organization in consolidating Local Section opinion within the District for report to the Board of Direction. ASCE Director Edmund Friedman, of Miami, then briefed the group on important Board actions at Los Angeles and stressed the importance of District meetings in enabling the Board to meet the wishes of the membership.

The agenda also included discussion of activities of ASCE, EJC, and the NSPE; Society finances; membership grades; redistricting; and methods of stimulating interest in Local Section affairs. The group went on record as favoring the establishment of the ECPD uniform grades for membership.

At the May luncheon meeting of the Georgia Section that launched the two-day conference, the group heard an interesting technical discussion on the use of prestressed concrete in structures. D. L. Chaney, structural engineer for the Portland Cement Association, explained the theory of prestressed design, but pointed out that the use of prestressed concrete in structures is still in the experimental stage and that new theories of design may be developed in the near future as other uses are found for prestressing.

Under a rotation plan adopted at the conference, next year's meeting will be under the auspices of the South Carolina Section, and the 1951 meeting chairman will be E. B. Rice, of Raleigh, N. C.

ASCE COMMITTEE ON STUDENT CHAPTERS, in recent meeting at Louisville, Ky., examines annual report of one of Chapters. Front row, left to right, shows Robert A. Marr, Jr., Finley B. Laverty, committee chairman, and G. Brooks Earnest, Board contact for the Committee. Standing are Robert H. Dodds, James M. Faircloth, D. M. Griffith, Craig P. Hazelet, and George W. Bradshaw.

"Civil Engineering" to Be Available in Microfilm

ASCE HAS COMPLETED an agreement with University Microfilms, of Ann Arbor, Mich., making CIVIL ENGINEERING available to libraries in microfilm form. Solving the problem of providing space for the large number of publications received by libraries, microfilm makes it possible to produce and distribute an entire volume of a periodical in a single roll, in editions of 30 or more, at a cost about equal to that of binding the same material in a conventional library binding.

Under the microfilm plan, libraries keep paper copies unbound until demand for them begins to subside when they are disposed of and microfilm substituted. Sales are restricted to subscribers to the paper edition, and film copy is distributed only at the end of the volume year.

The microfilm is furnished in positive form on metal reels, suitably labeled. Inquiries concerning purchase should be directed to University Microfilms, 313 N. First Street, Ann Arbor, Mich.

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ASCE-AGC Committee Aids Student Employment

TO IMPLEMENT ITS program of assisting student engineers to obtain summer employment on construction with contractors, the ASCE-AGC Joint Cooperative Committee has recently furnished AGC Chapters a list of all ASCE Faculty Advisers, with the request that they acquaint their members with the summer employment program and assist civil engineering students to get in touch with contractors.

One of the primary projects undertaken by the Joint Cooperative Committee at the time of its organization early in 1949, the summer employment plan is considered beneficial to the contracting industry in giving the engineering graduate an understanding of the contractor's problems. Since the inception of the program numerous AGC Chapters have not only assisted many students in obtaining summer employment but have also helped graduate engineers get positions.

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Metropolitan Juniors Sponsor Refresher Course

TO PREPARE ENGINEERS for Part III of the New York State Professional Engineers Licensing Examination, the Junior Branch of the Metropolitan Section is sponsoring an eight-week refresher course, to be held at the Engineers' Club, 32

West 40th Street, Wednesday evenings from 6:30 to 9, beginning August 23. Subjects to be covered are engineering economics, structures, hydraulics, and surveying. Fees are $10 to members of the Founder Societies, and $15 to nonmembers. For further information call or write Robert K. Lockwood, Education Committee, Junior Branch, ASCE Metropolitan Section, 33 West 39th Street, New York 18, N.Y.

Applications for the Part III examination are due in Albany, N.Y., by August 1, and the examination will be held Tuesday, October 24.

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ASCE Subcommittee on Drainage Is Activated

APPROVAL OF ACTIVATION of the American Society of Civil Engineers' Subcommittee on Drainage, under the chairmanship of Charles R. Maierhofer, Assoc. M. ASCE, head of the Drainage Engineering Division of the Bureau of Reclamation in Denver, is announced by the Society's Committee on Division Activities.

As a working unit of the ASCE Irrigation Division, the Subcommittee will formulate a program setting forth its functions and procedures within the organization. In addition to Mr. Maierhofer, the membership consists of W. W. Donnan, irrigation research engineer, Soil Conservation Service, Los Angeles; O. W. Israelsen, research professor, Utah State Agricultural College, Logan; R. C. Reeve, irrigation and drainage engineer, Regional Salinity Laboratory, Riverside, Calif.; and F. K. Muceus, regional head, Drainage Section, Soil Conservation Service, Portland, Ore.

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Alfred Noble Prize Should Be Stimulus to Authorship

ASCE MEMBERS UNDER 31 are reminded that they, in common with young members of the other Founder Societies and the Western Society of Engineers, can indirectly compete for the Alfred Noble Prize by submitting technical papers to the society with which they are affiliated for possible publication. Such papers reporting research, design, or operational projects and showing original, sound application of engineering principles will automatically be considered for the prize if they are accepted by the society to which the author belongs before his 31st birthday.

Established in 1929, the Alfred Noble Prize is a joint award of the Founder Societies and the Western Society of Engineers, under the trusteeship of the ASCE. It consists of a cash award currently amounting to about $350 and travel fare of the recipient to and from the place where the award is made. The award is derived from the income of a fund contributed by engineers and others in honor of Mr. Noble, who was a Past-President of ASCE and of the Western Society of Engineers.

Data on Job-Hunting Prepared for Graduates

MIMEOGRAPHED NOTES ON seeking an engineering job were mailed from Society Headquarters during the past spring to all ASCE Student Chapters. Additional copies of the six-page compilation, including a comprehensive bibliography, may be obtained from the Executive Secretary, 33 West 39th Street, New York 18, N.Y.

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Chicago Members Plan Fall Meeting

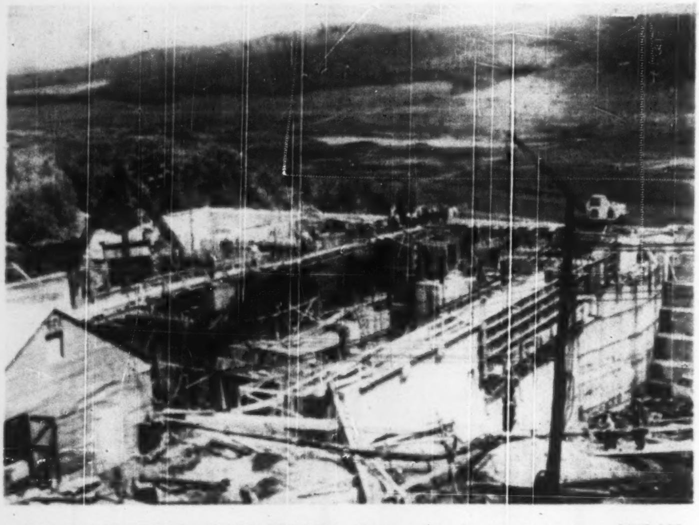
AN EXTENSIVE PROGRAM, featuring 19 sessions of the Technical Divisions of the Society, is being arranged by the committee in charge of the ASCE Fall Meeting in Chicago. Dates for this convention are October 11–14, and the headquarters in Chicago will be the Congress Hotel. Under sponsorship of the Illinois Section of ASCE, a full program of excursions and social events is also being planned.

All but one of the Technical Divisions are arranging sessions for the presentation of papers, round-table discussions, and reports on committee accomplishments. The full program of speakers and their subjects will be printed in the September issue of CIVIL ENGINEERING.

Because of its central location and extensive transportation facilities, Chicago has become famed as a convention city. Thus, plans are being made to accommodate an unusually large attendance of ASCE members and their families and guests.

Conferences of delegates from Local Sections and Student Chapters will be held concurrently with the Fall Meeting in Chicago. These will bring together representatives from a large area for discussion of Society and professional matters of current importance.

Metropolitan Section Juniors Visit Delaware Water Project



ABOUT 50 MEMBERS OF JUNIOR BRANCH of Metropolitan Section inspect new $375,000,000 Delaware Water Supply Project under construction in upstate New York on annual spring trip. Group is photographed on catwalks above Rondout intake to Delaware Aqueduct, through which water from Merriman Dam will flow. In background is site of proposed Rondout Reservoir, which will be formed by water impounded by Merriman Dam. When completed in 1955, new Delaware project will augment New York City supplies with 540 mgd. Photo through courtesy of New York Times.

San Francisco Section Forms Local Technical Committees

LOCAL TECHNICAL COMMITTEES, patterned after the committees of the ASCE Technical Divisions, are being inaugurated in the San Francisco Section at the request of the Society. Stating that it has many members anxious to participate in worth-while technical work, the Section is circularizing its members with a postcard inquiry concerning their interest in ASCE technical activities and their willingness to serve on local technical committees.

Advantages of such service at the Local Section level, it states, "are (1) neighbors cannot help inspiring their own high, continued interest in their fields, (2) better technical papers can result from better coordination at the local level."

To implement its program, the Section officers have appointed the following Technical Division chairmen: H. V. Lutge (chairman of all activities), Power; Robert Horonjeff, Air Transport; John G. Marr, City Planning; Harold Sjoberg, Construction; Eugene L. Grant, Engineering-Economics; R. A. Moyer, Highway; John K. Vennard, Hydraulics; R. V. Meikle, Irrigation; H. L. Thackwell, Sanitary; D. D. Leslie, Soil Mechanics; John E. Rinne, Structural; E. E. Hutchison, Surveying and Mapping; and Cabell Gwathmey, Waterways.

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Coming Local Section Events

Kansas City—Picnic to be held at Quivira on July 22.

Los Angeles—Seminar on planning the construction job at California Institute of Technology, Pasadena, July 12. Junior Forum beach party at Zuma Beach, July 15.

North Carolina—Joint meeting with North Carolina Society of Engineers, at Wrightsville Beach, August 18.

South Carolina—Summer meeting (ladies invited) at Fort Sumter Hotel, Charleston, July 21–22.

Scheduled ASCE Meetings

ANNUAL CONVENTION
Toronto, Canada, July 12–14
(Board of Direction meets
July 10–11)

FALL MEETING
Chicago, Ill., October 11–13
(Board of Direction meets
October 9–10)

SPRING CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets
February 19–20)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	May 11	22	Dinner meeting with several University of Akron students, as speakers.
Arizona	Apr. 21	...	Inspection tour of $4,000,000 cement plant of Arizona Portland Cement Co., at Rillito, Ariz.
	Apr. 22	...	Technical meeting. Student paper competition.
Brazil	April 15	27	Installation of officers. Guest speakers were George R. Strandberg, chief hydraulic engineer of Stone & Webster Engineering Corp., Boston, Mass., and Dr. Karl Terzaghi, soil mechanics engineer of Harvard University.
Buffalo	May 16	49	Luncheon meeting with Dr. Norman R. Gibson, Niagara Falls, N.Y., consultant, discussing methods of water measurement.
Central Illinois	May 9	48	Dinner meeting. ASCE Director Louis R. Howson was speaker of evening.
Central Ohio	Apr. 20	19	Dinner meeting with H. G. Wood, of Portland Cement Association, describing the construction of cement treated base.
Colorado	May 8	203	Joint dinner meeting with Student Chapter members of University of Colorado and University of Denver.
District of Columbia	May 9	75	Ralph E. Fuhrman, superintendent of District of Columbia sewage treatment plant, and Edwin R. Cotton, director of Interstate Commission on the Potomac River Basin, spoke.
Duluth	Apr. 17	22	Recent development of open-pit truck haulage was discussed by H. E. Farnam, Jr., of M. A. Hanna Co., Hibbing, Minn.
Florida Gainesville Sub-Section	May 9	...	Dinner meeting with Arthur Solee, county engineer of Duval County (Florida), speaking on development and background of Arlington bridge.
Georgia	May 5	...	Luncheon meeting with a discussion on prestressed concrete presented by D. L. Chaney, regional structural engineer, Portland Cement Association, Atlanta, Ga.
Illinois	May 17	...	Joint dinner meeting with Chicago chapter of Illinois Society of Professional Engineers.
	May 26	...	Luncheon meeting featuring presentation of Junior Membership certificates.
Indiana	Apr. 20	92	James Dankert, with Paul I. Cride, Inc., Indianapolis, Ind., acting as moderator of panel discussion on "What Can the Junior Do for the ASCE." Members of the panel included James T. Hallett, engineer of roads, Indiana State Highway Commission; John M. Hayes, professor of structural engineering, Purdue University; H. Hilden Lacy; and Samuel R. McGurk, sanitary engineer, Indiana State Board of Health.
Intermountain	Apr. 17	41	Dinner meeting. ASCE President Ernest E. Howard and Vice-President Henry J. Sherman outlined Society activities.
Iowa	May 18	99	Joint meeting with Student Chapter members of Iowa State College and State University of Iowa.
Ithaca	May 18	...	Dinner meeting with Director Otto Holden speaking on development of power on Ottawa River. Junior membership prize was awarded to Neil Fitz-Simons, of Cornell University Student Chapter.
Kansas	May 11	72	Joint meeting with Kansas State College and University of Kansas Student Chapters. Milton D. Pollitt, of Kansas State College, and James B. Coulter, of University of Kansas, were awarded Junior Membership in Society. Dean M. A. Durland, of Kansas State College, presented an address on the employment outlook for engineers.
Kentucky	May 4	...	Joint meeting with University of Louisville and University of Kentucky. Section Junior membership awards were presented to J. W. Long, of University of Louisville; and J. W. Pochomis, of University of Kentucky. Winners in speaking contest were E. P.

			Faulconer, University of Kentucky; A. K. Rouben, University of Louisville; and R. L. Houlette, who received first, second, and third prizes, respectively.
Los Angeles	May 10	137	Joint meeting with California Institute of Technology Student Chapter.
Louisiana	May 5	78	Joint meeting with Louisiana State University Student Chapter. Don Reynolds, assistant to the ASCE Secretary, spoke on integration of students into the profession. Methods of stabilization of rivers were discussed by Walter Carey.
Metropolitan	May 17	250	Donald J. Belcher, head of department of transportation, Cornell University, and senior member of firm of Donald J. Belcher & Associates, lectured on "Aerial Photographs—an Index to Engineering Problems." Presentation of Robert Ridgway Prize awards to: Samuel Kramer, College of the City of New York; Herbert J. Johnson, Columbia University; Joseph Paduana, Cooper Union; Edwin R. Daly, Manhattan College; Richard C. Bunten, Newark College of Engineering; Eugene D. Jones, New York University; George C. Driscoll, Jr., Rutgers University; and Francis Abadie, Polytechnic Institute of Brooklyn. New Metropolitan Section officers for coming year will be: William S. LaLonde, president; J. P. Riley, vice-president; Alfred Hedefine, secretary; and Charles E. Trout, treasurer.
Miami	May 4	23	Dr. H. H. Sheldon, professor of industrial engineering, University of Miami, presented speech entitled, "Engineering Reports for Laymen."
Mid-South	May 18-19	120	Spring meeting with technical sessions devoted to discussion of Bull Shoals Dam, road problems, and industrial programs in Arkansas.
Oklahoma	May 19	...	Dinner meeting with Clarence Birch, chairman of State Planning and Resources Board, as speaker.
Oklahoma City Branch	April 4	...	F. S. Baker gave a brief history of the $36,000,000 Oklahoma City bond issue.
	May 19	...	J. S. Clark talked on the problems and work of State Planning and Resources Board.
Philadelphia	June 13	...	Junior Forum meeting with election of officers and social afterwards.
	June 13	...	June outing at Bala Golf Club.
Puerto Rico	Apr. 29		Field trip to water filtration plant of Puerto Rico Aqueduct Authority at Trujillo Alto. James R. Cook, field engineer of the plant, conducted the tour.
Rochester	Apr. 26	...	Howard S. Thomas, New York consultant, spoke on "Northwestern New York Water Authority."
Sacramento	April 18	65	Luncheon meeting with ASCE President Ernest E. Howard talking on Society affairs.
	April 25	113	Luncheon meeting. R. Robinson Rowe, of California Division of Highways, reported on Student Chapter and Junior Forum activities.
St. Louis	Apr. 24	130	Joint meeting with Washington University Student Chapter. H. E. Crider, with the Bethlehem Steel Co., led a discussion on the erection of steel superstructure of the bridge being built across the Mississippi River by the City of East St. Louis, Mo.
Seattle	Apr. 26	117	Meeting with University of Washington Student Chapter. Student paper competition—John Miles being awarded Junior membership prize by Section. Other speakers included Harrison Kramer, consulting engineer, James W. Carey & Associates, Seattle; and Tom Campbell, superintendent of construction, Stone & Webster Engineering Co., Seattle.
Tennessee Valley Chattanooga Sub-Section	May 9		J. A. Vaughan, research engineer, Southern Wood Preserving Co., presented speech entitled, "Treatment, Preservation, and Economics of Treated Wood."
Tri-City	May 17	41	Speaker of evening was V. R. Bennion, district engineer, U.S. Geological Survey, Iowa District, whose subject was "Use of Streamflow Records in the Design of Highway Bridge Openings."
West Virginia	May 19		Inspection tour to Compass Coal Co. and Dick Construction Co., in Barbour County, Virginia. Dinner meeting with G. G. Greulich, consulting engineer, Carnegie Illinois Steel Corp., Pittsburgh, Pa., speaking on development of steel sheet, bearing piling, and steel grid flooring.

West Coast Sections Hear President Howard

ASCE membership is up 400 percent, but publications are down 65 percent, ASCE President Ernest E. Howard told members of the San Francisco Section at a recent dinner meeting. He said that since 1913, when there was a membership of 7,000, publications at the national level have dropped until there is an acute need for a more complete record of the accomplishments of the profession. It is not reasonable to believe, he concluded, that publication of 50 or 60 papers a year is adequate technical achievement for an organization like ASCE.

President Howard was also principal speaker at a recent joint meeting of the Oregon Section and the Oregon State College Student Chapter, which was attended by 128. Discussing the future for young engineers, he made optimistic predictions for the role of the profession in the even greater industrial expansion to be expected in the next generation.

ON RECENT WEST COAST TOUR President Howard discusses Society activities with Glenn B. Woodruff, president of San Francisco Section (left in lower photo) and J. G. Wright, chairman of Program Committee of San Francisco Section. At Oregon Section meeting (upper view) he is shown with ASCE Director Morris Goodkind (left) and Oregon Section President Robert E. Cushman.

TOTAL MEMBERSHIP AS OF JUNE 9, 1950

Members	7,627
Associate Members	9,810
Honorary Members	39
Junior Members	11,379
Affiliates	73
Fellows	1
Total	28,929
(June 9, 1949	25,900)

NEWS BRIEFS

Brooklyn-Battery Tunnel Is Opened to Traffic

An $80,000,000 twin tube, connecting Manhattan Island at the Battery with Gowanus Parkway in Brooklyn, was officially dedicated on May 25 by Mayor O'Dwyer and other city and borough officials. Opening of the 9,117-ft crossing, longest under-water tunnel in the country and second longest in the world, constitutes the first new vehicular link between lower Manhattan and Brooklyn in 41 years. Following the pattern of similar tunnels built in recent years, the twin tubes feature only one innovation—shadowless fluorescent lights, varying in intensity from 20-ft candles at the tunnel entrances to 2 1/2 ft candles in the central part, 115 ft below the water, which will eliminate glare.

Paying tribute to the engineers, workmen, and others who had a hand in the project, Mayor O'Dwyer had special praise for Robert Moses, chairman of the Triborough Bridge and Tunnel Authority and city construction coordinator, whom he held primarily responsible for "this magnificent improvement." The Mayor said that he envisaged the project as a vital link in a network connecting the East and West rather than just two boroughs of the city. Emphasizing the soundness of methods chosen for financing the crossing, he stated, "It couldn't have been built with city money. It had to be financed by the sale of bonds, and the people who use it should pay for it."

All speakers, including Mr. Moses and George E. Spargo, M. ASCE, general manager of the Triborough Bridge and Tunnel Authority, stressed the fact that the full effect of the new crossing in relieving the traffic situation will not be felt until completion of vital connections that are still under construction or in the advanced planning state. The Battery Park Underpass (see article elsewhere in this issue), which will divert tunnel traffic to and from the Franklin D. Roosevelt Drive, will not be completed until late this year. In Brooklyn two important sections of the Brooklyn-Queens Expressway are lacking. On the credit side is the fact that the Battery Parking Garage is scheduled for completion about July 1. The first publicly owned parking garage in the city, the seven-story structure will accommodate 1,050 cars.

Started in 1940 with RFC funds, the project was originally scheduled to cost $57,000,000. Completion was delayed by wartime restrictions on building that stopped tunneling from the latter part of 1942 until the end of 1945, and by financing difficulties resulting from spiraling postwar construction costs. Since 1946 work has been under the direction of the Triborough Bridge and Tunnel Authority, which was formed by state law to expedite financing of the project. The engineering staff of the Authority is headed by Ralph Smillie, M. ASCE, chief engineer, and ASCE Director William McK. Griffin, deputy chief engineer.

OFFICIAL RIBBON CUTTING at opening ceremonies in Manhattan Plaza of Brooklyn Battery Tunnel is handled by Mayor O'Dwyer. Photo shows (left to right) two unidentified city employees; Vincent Impelliteri, president of New York City Council; John Cashmore, president, Borough of Brooklyn; Cardinal Spellman, who delivered invocation; Robert F. Wagner, Jr., president, Borough of Manhattan; Robert Moses, chairman, Triborough Bridge and Tunnel Authority; the Mayor; Joseph J. Delaney, vice-president, International Union of Operating Engineers; George V. McLaughlin, vice-chairman, Triborough Bridge and Tunnel Authority; and George E. Spargo, M. ASCE, general manager, Triborough Bridge and Tunnel Authority, and master of ceremonies.

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Statler Co. Awards Contract for Big Los Angeles Hotel

A contract for one of the West Coast's biggest postwar construction projects, a Statler Hotel and office building in downtown Los Angeles, has been awarded to Robert E. McKee, General Contractor, Inc., of Los Angeles and El Paso, according to an announcement from the Hotels Statler Co., Inc. With actual work on the $20,000,000 development beginning July 5, the project is scheduled for completion within two years.

The largest hotel constructed anywhere in the past 20 years, the 1,275 room structure will include such features as a swimming pool in a patio, an escalator from the motorists' lobby to the main lobby, television in every room, and a 475-car underground garage. The project will also relieve the office-space shortage in downtown Los Angeles by making available 150,000 sq ft of additional office accommodations.

Architect-engineer for the project is the Chicago firm of Holabird & Root & Burgee, and William B. Tabler, of New York City, is associate architect.

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VA Seeks Bids on 500-Bed Oklahoma City Hospital

Sealed bids for the construction of a 500-bed Veterans Administration hospital in Oklahoma City, Okla, will be accepted until July 25, according to an announcement from the Technical Service of the VA. The project will include a 5,060,000-cu ft main hospital building, an apartment building, attendants' quarters, and various servicing plants and structures, including a 3,000-cu ft underground reservoir. Separate bids may be submitted for (1) general construction, (2) electric elevators and dumbwaiters, and (3) refrigerating equipment.

Drawings and specifications may be obtained by writing to the director of the Technical Service, Veterans Administration, Washington 25, D.C. Bids, prepared in triplicate on standard government forms, should be sent to the director of the Construction Service, VA, at the same address.

Cornerstone Is Laid for Owls Head Pollution Plant

Elimination of the present dumping of about 120,000,000 gal of raw sewage along the Brooklyn waterfront from 42nd to 92nd Streets will be achieved by the Owls Head Pollution Control Project, which is scheduled for completion in May 1951. At recent cornerstone-laying ceremonies at the main building of the plant—the Pump and Power House—Mayor O'Dwyer advocated imposition of a sewer rental tax as a means of financing such public works projects, which he called an "investment in the health of the people." The Mayor also stressed the benefit to Coney Island and Staten Island beaches that will result from operation of the plant. (Since the Mayor's talk, the New York City Council has approved imposition of a sewer rental tax, and the Mayor has signed the ordinance.)

Several contracts for construction of the $21,000,000 Owls Head Project are held by the Thompson-Starrett Co., Inc., of New York. With a capacity of 160 mgd, the completed plant will serve a population of 1,200,000, and will be the first designed to employ exclusively the high-rate activated sludge process.

The Owls Head Project represents a substantial advance in the city's $100,000,000 five-year sewage-disposal program, which is being financed as special assessment improvement.

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New Manager Appointed for ESPS Detroit Office

The Engineering Societies Personnel Service, Inc., announces the appointment of Lt. Col. Frank McKinless as manager of its Detroit Office.

Colonel McKinless is a graduate of the Colorado School of Mines, with over 25 years of experience in the design, production, sales, and management fields. He has served with the Marine Corps in both World Wars and was in charge of Personnel Procurement for the Marines in the New York District during World War II.

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Contract Let for Addition to Utica, N.Y., Hospital

Following the recent award of a $3,780,000 construction contract by the Public Works Department at Albany, to the Merritt-Chapman & Scott Corp., of New York, work has started on a 718-bed medical-surgical unit for the New York State Hospital at Utica. With pile driving and excavation already under way, construction is scheduled for completion by September 1952. Weiskopf & Pickworth, of New York, are the consulting engineers.

The present unit is the second being constructed by Merritt-Chapman & Scott for the New York State Department of Mental Hygiene. Another is nearing completion for the State Hospital at Poughkeepsie.

Center for Cement and Concrete Research Is Dedicated

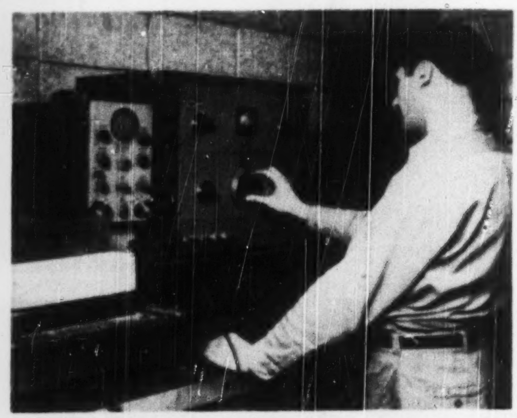
Civilization's best chance of surviving an atomic war is to make maximum use of concrete in building its towns and cities, according to A. Allan Bates, vice-president for research and development of the Portland Cement Association.

Speaking at the dedication of the Association's new $3,000,000 research and development laboratories in Chicago on June 8, Dr. Bates stated that, "Reinforced concrete structures, properly designed, possess a unique combination of impenetrability to deadly atomic radiation, resistance to blast destruction, safety against fire, and last but not least, economic feasibility."

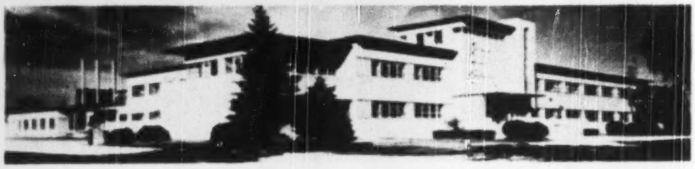
Noting that early discoveries in the prestressing of concrete were made in the United States, Dr. Bates hailed the method as "giving promise of major improvements and economies in constructing bridges, factories, commerical buildings and other structures." Research and development work to advance the application of prestressed concrete will be one of the prime missions of the new PCA Research and Development Laboratories, he said.

Several hundred leading scientists and engineers attending the dedication also heard addresses by ASCE Honorary Member Charles F. Kettering, director and research consultant for General Motors; Frank T. Sheets, M. ASCE, president of the Portland Cement Association; and W. C. Russell, M. ASCE, chairman of the board of the PCA. Following the ceremonies, visitors were conducted on an inspection tour of the two-acre research development, which is located in the Chicago suburb of Skokie, Ill.

A national, non-profit organization to improve and extend the uses of portland cement and concrete, the Association was established in 1916. It has 67 member companies, which produce about nine-tenths of the portland cement used in the United States and Canada.



SONIC-TESTING apparatus (left), used for durability studies on concrete specimens that have been subjected to hundreds of cycles of freezing and thawing and wetting and drying, gives information of value in increasing durability of concrete mixes. Machine is one of many pieces of unusual scientific equipment to be found in Association's new Research and Development laboratories.



NEW RESEARCH AND DEVELOPMENT laboratories of Portland Cement Association, providing 98,000 sq ft of usable floor space, triple the Association's former research facilities. Demonstrating both structural and decorative aspects of concrete, the laboratory group of two buildings, joined by covered walkway, constitutes world's largest and most completely equipped research center for cement and concrete.

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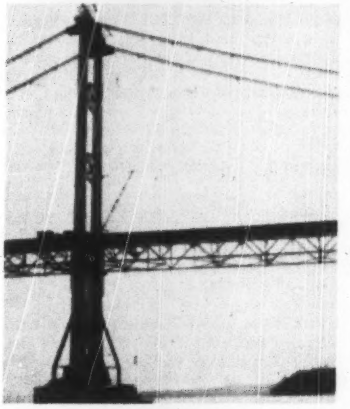
Concrete Pipe Groups Form New Association

Announcement is made of the recent formation of the American Concrete Agricultural Pipe Association, a non-profit trade organization to promote the interests of the concrete irrigation pipe and concrete drain tile industry, and affiliation of the new group with the American Concrete Pipe Association and the American Concrete Pressure Pipe Association.

The three national concrete pipe groups will coordinate their activities as members of a joint coordinating and affiliating association known as Concrete Pipe Associations, Inc. As managing director of all three organizations, Howard F. Peckworth, M. ASCE, will direct the joint group, which has its offices in Chicago.

New Tacoma Narrows Bridge Nears Completion



RECONSTRUCTION OF Tacoma Narrows Bridge, shown here in two views, nears completion after more than two years of work. Built at cost of $14,000,000 after extensive model investigation at University of Washington, structure utilizes in modified form main concrete piers and abutments left from old structure. Entirely new four-lane superstructure, consisting of 2,800-ft main suspension span and 100-ft side suspension spans, replaces two-lane structure that collapsed in high wind in 1940. Structural steel towers are 40 ft higher than towers of original structure and carry suspension cables 21 in. in diameter. New design includes deep stiffening trusses, top and bottom lateral systems, trussed stringers at edge of roadway, and wind slots in roadway slab. Energy-absorbing devices in form of hydraulic cylinders at towers and in diagonal ties at center of main span furnish additional damping in structure. Charles E. Andrew, M. ASCE, is chief consulting engineer for Washington Toll Bridge Authority, which built project. Photos furnished by Tacoma Section, which sponsored tour of Pacific Northwest Conference to project (page 52).

Second Highest Payroll in Steel History Reported

THE TOTAL PAYROLL of the iron and steel industry last year was the second highest in history and average hourly wage rates were the highest ever recorded, according to an announcement from the American Iron and Steel Institute. Totaling $2,061,770,000, the 1949 payroll was exceeded only by that of 1948 which came to $2,234,461,000. The payroll for the first nine months of the year was higher than ever before, but the strike of steelworkers during October and November lowered the year's total. Data used by the Institute are based on reports from 118 companies representing approximately 94 percent of the capacity of the industry.

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Construction Activity in May Sets New Record

NEW CONSTRUCTION PUT in place in May, valued at more than $1.9 billion, exceeded even the seasonal fall peaks of 1948 and 1949, according to a joint report of the Construction Division of the Department of Commerce and the Department of Labor's Bureau of Labor Statistics. The total for the month represented a greater than seasonal increase of 14 percent over the April estimate and of 23 percent above the May 1949 total. Part of this expansion is attributed to increases in private home building and to substantial rises in highway construction.

Included in expenditures for private construction, which totaled $1.4 billion and represented an advance of 12 percent over April and of 27 percent over last May, were increased outlays for homebuilding and larger than seasonal increases in construction of stores and other types of commercial buildings. A three-year down-trend in factory building was also reversed during the month. Included in public construction expenditures for the month, estimated at $531 million, were a 52 percent increase in highway construction over the previous month and substantial increases in reclamation and flood control.

Both private and public construction advances are included in the total value of nearly $8.1 billion placed upon all types of new construction put in place during the first five months of 1950. This total is 21 percent above that for the corresponding period in 1921, the joint report declares.

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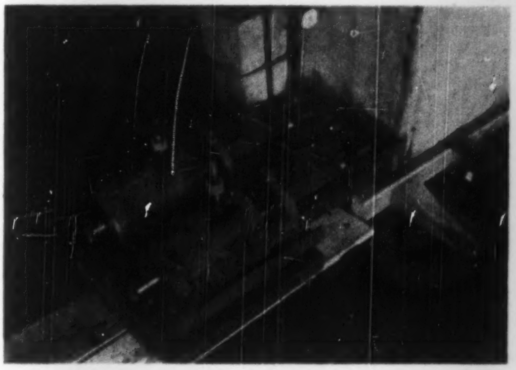
Special Nuts Permit Use of 1-In. Steel Bars in Prestressing Concrete

THE USE OF large-size steel bars up to $1^1/_8$ in. in diameter in prestressing concrete has been introduced in England (until now only $^1/_4$-in. wires or smaller were used). The corrosion-resistant bars are held against end plates by specially designed nuts strong enough to resist failure should the beam be overloaded to destruction. Where long lengths are required the bars may be connected by special couplers that develop the full strength of the bar.

The steel used in the process is a new high tensile alloy with an ultimate strength of 160,000 psi. Since the steel is not subject to creep at the working stresses, there is a reduction in the loss of prestress compared with the usual cold drawn carbon steel wire. Relatively ductile, the new alloy steel is expected to have applications out of the prestressing field. It has a working tensile stress approximately four times that of ordinary mild steel, permitting great economies in weight when used for tie bars for sheet piling, wind bracing, and similar purposes.

The large-size bars also permit economies over previous prestressing methods, since fewer are needed per beam and there is a consequent reduction in the amount of labor required to apply the prestressing.

Patents held by Donovan Lee, M. ASCE, consulting engineer of London, cover the method of manufacture of the alloy steel, the jacks, and the various special components. The development has been made in conjunction with McCall & Co., Ltd., reinforcement and welded fabric manufacturers of Sheffield, England.



IN PRESTRESSING, new-type jacks (two of which are shown here) capable of applying up to 45 tons each are used to load bars. Holes in connecting plate, not readily visible, permit removal of jacks.

Water Use Laws Reported at AWWA Annual Meeting

Laws governing water use in the various states were reviewed at the recent annual meeting of the American Water Works Association in Philadelphia by a committee headed by Richard Hazen, M. ASCE, of the New York engineering firm of Malcolm Pirnie Engineers. In the same session G. E. Ferguson, Assoc. M. ASCE, described the present status of water resources legislation in Congress, pointing out that "the nation's water resources are receiving increasing attention in Congressional legislation." Water bills before the 81st Congress place increasing stress on the comprehensive investigation of water as a base for development, he said.

Reporting early results of a fluoridation program in Newburgh and Kingston, N.Y., during another leading session, Charles R. Cox, Assoc. M. ASCE, water superintendent for the New York State Department of Health, stated that early results indicate a 30 percent reduction in tooth decay since the program was started in 1945. For this reason the state has modified its restrictions on fluoridation of water.

Recipients of AWWA awards made during the four-day program include W. Victor Weir, M. ASCE, newly elected president of the AWWA, A. E. Berry and A. P. Black, who were awarded the John M. Goodell Prize for a joint report on the use of fluoride in public water supplies. The John M. Owen Award went to Joseph P. Schwada, Assoc. M. ASCE, city engineer of Milwaukee, Wis. ASCE Members G. W. Pracy, of San Francisco, and Jack Hinman, of Iowa City, were elected to honorary membership in AWWA.

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Large Air Missile Test Center Rises at Point Mugu

Official U.S. Navy Photograph

WITH INITIAL $14,000,000 CONSTRUCTION APPROPRIATION, made available by Congress in 1948, work is proceeding on permanent facilities for large U.S. Navy Air Missile Test Center at Point Mugu, Calif. Already built or under construction as first increment of proposed $30,000,000 program are testing, instrumentation, administrative and recreational buildings, 2-mgd water supply, standard double hangar of 110,000-sq ft capacity, and numerous other facilities. Present view shows construction of missile test building and small missile building, with hangar and operations area in background. Second phase of construction, which is contingent upon appropriation of additional $16,000,000, will consist of 34 separate projects for missile launching and other technical work. Upon conclusion of entire program, Center will be most modern and complete missile testing station in world.

Volcanic Steam Used for Power Production in Italy

Successful harnessing of volcanic steam to produce electricity for power-poor Italy, under sponsorship of the Marshall Plan, is reported in a recent issue of the *Marshall Plan News*. Utilizing steam created far below the earth's surface by rain water seeping down through layers of semiporous rock to deep-lying beds of hot lava, the geothermic power plants, known as Lardarello, are located in a remote volcanic section of Tuscany, about 40 miles south of Florence.

First efforts to put the volcano-created steam to work were made without success about 75 years ago. More successful attempts, made during the late thirties and early years of World War II, resulted in the production by 1944 of 800,000,000 kwhr of power a year from the Lardarello steam. However, turbines and generators required for the project were destroyed by the retreating Germans. Since 1948, Marshall Plan funds have speeded repair of the damage by American and Italian engineers and technicians, with the result that the project currently produces about 1,000,000,000 kwhr a year.

With new wells being bored, it is estimated that the Lardarello works will account for $7^{1}/_{2}$ percent of Italy's total power production. "With no coal to buy and no boilers to install and no dams to build, the power will be the cheapest in the world," according to the report. The source of supply is expected to last indefinitely.

◆

New Treatment Plant Will End Jamaica Bay Pollution

To eliminate the dumping of raw sewage into Jamaica Bay, the New York City Department of Public Works has awarded a $3,248,966 contract to the Merritt-Chapman & Scott Corp., of New York, for construction of the Rockaway Sewage Treatment Works, according to Public Works Commissioner Frederick H. Zurmuhlen, M. ASCE. Equipped to serve the entire Rockaway Peninsula population of 90,000, the plant is designed to treat 15 mgd and for ultimate expansion to handle 30 mgd. Designers were the Boston engineering firm of Metcalf & Eddy in cooperation with engineers of the Public Works Department.

Completion of the project, scheduled for late 1951 or early 1952, will provide final facilities planned by the Department of Public Works for treating all sewage entering Jamaica Bay. Three other treatment plants—Coney Island, 26th Ward, and Jamaica—comprise the present system.

Ambitious Road Program Is Initiated in Alaska

Plans for a large program of road construction and maintenance in most of the inhabited regions of Alaska in 1950 are announced by the Alaska Road Commission. An increase of 36 percent for maintenance over last year is scheduled. Because of the increase in traffic in the territory, year-round maintenance is planned for the Alaska Highway, Glenn Highway, part of the Richardson Highway, and many local roads. The largest single improvement now under way is the paving program. Last year 145 miles of main highway were paved with a light bituminous surface, and contracts have already been let with available funds for the paving of over 200 miles more in 1950.

New road construction will include completion of the Sterling Highway connecting Homer and Kenai with Seward. Construction is also progressing rapidly on the new road to connect Anchorage with Seward and the Kenai Peninsula. Along Turnagai Arm the entire project is under contract, and it is hoped that by the end of 1950 the road can be opened to limited traffic. The project, called one of the most important in Alaska, is being handled as a cooperative undertaking of the Alaska Road Commission, the Bureau of Public Roads, and the Alaska Railroad. Completion of the entire highway, which will link the whole of the Kenai Peninsula to the outside world, is planned for 1951.

New N.Y.C. Traffic Unit Replaces Commission

Creation of a New York City Department of Traffic, in place of the present Traffic Commission, and appointment of Lloyd B. Reid, M. ASCE, as Commissioner of Traffic, has been announced by Mayor O'Dwyer. T. T. Wiley, M. ASCE, executive director of the Traffic Commission since its formation in February 1949, has been appointed deputy commissioner. Mr. Reid, a traffic expert and former traffic engineer of Detroit, has served as consultant to the City Traffic Commission. Appointment of a second deputy commissioner will be made later.

The Mayor emphasized the fact that the new three-man agency will be expected to undertake engineering studies, and to review the findings of other engineering specialists. Studies of a proposal to alleviate traffic congestion by construction of five public parking garages on selected sites are currently being made by the New York firm of Madigan & Hyland.

◆

Home-Building Program Reaches Record High

Reporting the start of 126,000 new dwelling units in April in a recent Washington Letter, the National Association of Home Builders in the United States points out that this number "exceeds by 16,000 the previously highest month, which was March 1950 . . . and is 37,700 higher than April 1949. It represents more houses and apartments than were started in the entire year of 1933 and is equal to the total starts in 1934. It brings the total for the first four months of 1950 to 396,000 units, nearly equaling the total volume of 406,000 in 1938 and 53.4 percent above the 258,100 units started in the first four months of the record-breaking year 1949. It gives promise of our reaching a minimum of 1,200,000 units during 1950."

Predicting that "this vast volume of construction may be expected to result in substantially increased building costs," the report notes recent rises in the cost of lumber and some metal items and states that, in addition to costing more, many building materials will be in short supply.

◆

Expansion of Nation's Airport Program Urged

The necessity of keeping the nation's airport program abreast of economic and defense needs was stressed by H. G. Sours, Assoc. M. ASCE, consulting engineer of Columbus, Ohio, and director and past-president of the American Road Builders' Association, in a talk before the American Association of Airport Executives in recent convention at Columbus, Ohio. Stating that "our airport program must never be allowed to develop a lag" similar to that in our highway construction program, he pointed out that the strategic value of the nation's largest airports in time of emergency could be greatly enhanced by correcting present deficiencies in roads and streets linking the fields with the urban centers they serve.

Airport development currently is at a rate far below that expected when the 79th Congress first set up machinery for federal participation in civil airport development, Mr. Sours declared. As a result, the present Congress is being asked to extend to ten years a federal airport program originally contemplated for five years. Though the national average is about two airports to each county, 900 counties have no airfields at all. The need for more even distribution of airfields by addition of airports to the current total of 6,500 is obvious, he concluded.

◆

Engineering Educators Told of Need for Conservation

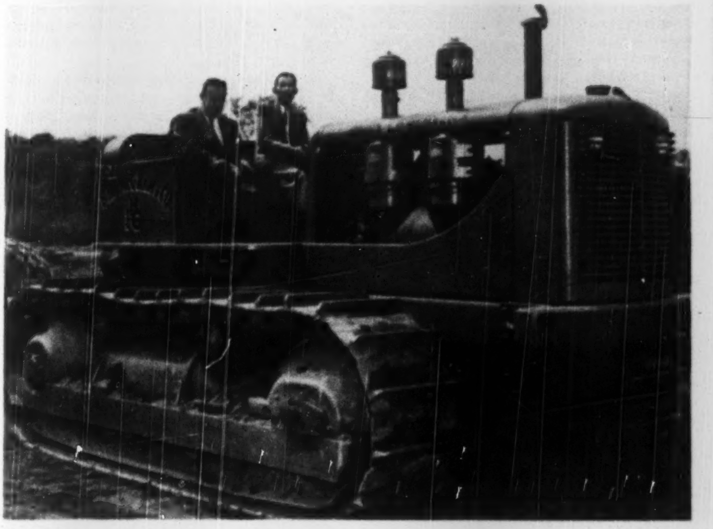
Conservation is a matter of vital international significance as well as an all-important domestic consideration, according to James H. Allen, M. ASCE, executive secretary of the Interstate Commission on the Delaware River Basin. Speaking at a meeting of the Middle Atlantic Section of the American Society for Engineering Education, held recently at Lehigh University, Mr. Allen deplored the serious depletion of our natural resources and the pollution of our streams. If the United States is to maintain world leadership, he maintained, it "must more effectively utilize its natural resources from this point on."

To achieve this end, he advocated passage of a national conservation law that would aid in the development of "sound natural resources programs throughout the nation" and encourage participation in such programs at the local levels directly affected. "It is my strong conviction," he said, "that conservation programs should spring up from the lowest level of government that can perform them with reasonable efficiency and promptness and that, in no case, should exclusive control rest in the federal government under systems patterned upon TVA."

Stressing the fact that conservation of natural resources is primarily the job of the engineer, Mr. Allen told the assemblage of engineering educators that they "have the major responsibility for driving that message home."

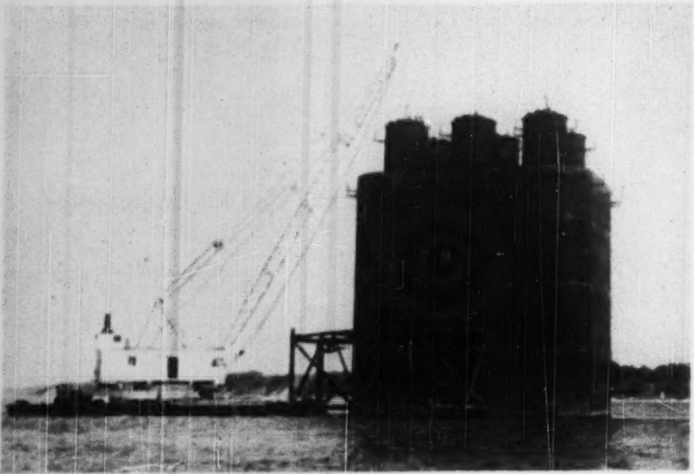
A program of general studies for college engineering students "to develop a sense of the highest social responsibility in each individual" was proposed during an afternoon panel discussion. More than 300 delegates, representing 24 institutions in six states, took part in a symposium on the subject, "The Dilemma in Engineering Education and a Possible Solution."

Modern Construction Equipment Goes to Work on Large Housing Project



CONNECTICUT'S GOVERNOR CHESTER BOWLES (left) attends recent ground-breaking ceremonies for $3,000,000 Hartford Housing Project. With him is Urban D. Gosselin, Assoc. M. ASCE, vice-president of F. H. McGraw & Co., which has construction contract on project. To complete the 360-unit housing project in the required 365 days, builder will make full use of big construction equipment and mass-production methods.

Caisson Is Readied for Sinking at Yorktown Bridge Site



FIRST SECTION OF MAMMOTH DOUBLE SWING-SPAN BRIDGE, to be built on Route 17 at Yorktown, Va., completes floating voyage from docks of Newport News Shipbuilding and Dry Dock Co. at Newport News to York River Bridge site some 40 miles away. Caisson is shown pushed between steel towers driven into exact position in river bed. Filling caisson with concrete and sinking it below river bed is expected to require months. Joint contract for substructure is held by Massman Construction Co. and Kansas City Bridge Co., both of Kansas City, and Virginia Bridge Co., of Roanoke, will build superstructure. Cost of bridge and approaches is estimated at $9,000,000.

Design of Structures to Resist Atomic Blast Recommended

TENTATIVE RECOMMENDATIONS FOR the construction of buildings and bridges to resist or reduce the effects of atomic blast are made public in a mobilization planning report recently released by the National Security Resources Board. Entitled *Damage from Atomic Explosion and Design of Protective Structures,* the mimeographed report was prepared jointly by the Atomic Energy Commission and the Department of Defense.

Present recommendations for the design of multi-story reinforced concrete or steel-frame buildings suggest "that the designer assume a horizontal wind component of 90 psf and a vertical component of 70 psf for protection against structural collapse from an atomic bomb releasing the energy equivalent of 20,000 tons of TNT, exploding at a horizontal distance of one-half mile and height of approximately 2,000 ft." The report also suggests that the design of buildings and their component parts follow the methods, allowable stresses, and details employed in wind or earthquake-resistant design.

The foregoing recommendations are based on experiences in Japan for this type of building limited to 100 ft in height. Stating that wind load is believed to be the best basis for design to resist blast, the report points out that, "Design for a 90-lb horizontal component wind load compares roughly with an earthquake-resistant design for a lateral force equal to 10 percent of the weight. Since earthquake-resistant buildings in Nagasaki suffered no damage to the frame at 2,000 ft and beyond, this appears to be reasonable."

Strengthening existing structures and reducing hazards, according to the experts, is "a much more difficult problem than that of incorporating necessary measures in design." For such buildings, principles to be followed in providing shelter areas are outlined.

In a table of proportionately reduced pressures for buildings erected at increasing distances from probable target centers, the air burst of an atomic bomb 1,000 ft from the target is listed as having a wind velocity of 800 mph and causing the decks of steel plate girder bridges to shift laterally. At 1,500 ft from the target, the table shows mass distortion of heavy steel frame buildings, and loss of roofs and panels, and at 2,000 ft (with wind velocity of 550 mph) severe structural damage to earthquake-resistant reinforced concrete buildings. At 2,500 ft, virtually complete destruction of all buildings, other than reinforced-concrete aseismic design, is noted. The table gives data up to 12,000 ft from the target, where the wind velocity was 80 mph, and lists "light damage to window frames and doors, moderate plaster damage, and complete window damage."

Copies of the full report may be obtained from the Government Printing Office, Washington 25, D.C., at 10 cents each.

Meetings and Conferences

Fourth International Congress of Soil Science. The Fourth International Congress of Soil Science is scheduled for Amsterdam, Netherlands, July 24–August 1.

Fourth World Power Conference. The Fourth World Power Conference will be held in London, England, July 10–15, with tours July 15–23. Inquiries should be addressed to Gano Dunn, Executive Commissioner of United States National Committee, 80 Broad Street, New York City, or to C. H. Gray, Secretary, European Headquarters, 201 Grand Place, Trafalgar Square, London, W.C. 2.

International Trade Fair. Exhibits of building materials, machinery, and equipment will be a major feature of the first United States International Trade Fair, to be held in Chicago, Ill., August 7–20.

NEW IN Education

A PHOTOGRAMMETRY SEMINAR—sponsored jointly by the University of Denver, Committee 8 on Surveying and Mapping of the American Society for Engineering Education, and the Rocky Mountain Section of the American Society of Photogrammetry—will be held on the campus of the University of Denver, August 7–11. Intended primarily for teachers of surveying and mapping, the program will consist of papers on course content, position of photogrammetry in the curricula, prerequisites, equipment, and other problems facing educational institutions. For further information write Arthur J. McNair, Chairman of Program Committee, Civil Engineering School, Cornell University, Ithaca, N.Y., or Prof. L. J. Goldsmith, Chairman of Local Arrangements Committee, Civil Engineering Department, University of Denver, Denver, Colo.

MORE THAN 500 representatives of industrial concerns and engineering schools in the Eastern United States attended a recent all-day conference at Swarthmore College devoted to engineering education and its relation to the needs of industry. The conference was under the auspices of the college and the American Society for Engineering Education.

TO INCREASE INTEREST in landscape design and roadside protection among students of highway engineering, the New Jersey Roadside Council is cooperating with the Rutgers University Engineering School in presenting a lecture series. The series will center about the theme, "Landscape Design and Its Relation to the Modern Highway."

TO PROMOTE STUDY in practical hydrology the Cooper Union Alumni Association has given $10,000 to the institution for the construction of a small dam on the Ringwood River at Green Engineering Camp in Passaic County, New Jersey. According to Prof. Frank C. Mirgain, Assoc. M. ASCE, head of the department of civil engineering, the project will supplement academic work in hydrology.

ENGINEERING RESEARCH IN the Pacific Northwest was discussed during sessions of the recent annual convention of the Engineering College Research Council of the American Society for Engineering Education at the University of Washington, with Dean F. M. Dawson, M. ASCE, of the State University of Iowa, presiding at the session entitled "Research and the Future of the Pacific Northwest." Other symposia dealt with industrial and federal research in the area. In the latter session, D. W. Applegate, Assoc. M. ASCE, chief of the Construction Section, Regional Branch of Design and Construction of the U.S. Bureau of Reclamation at Boise, Idaho, spoke on lower-cost canal linings.

EDUCATORS FROM ALL over the country and representatives of national engineering societies attended the recent University of Dayton Centennial Convocation. The Society was represented by H. L. Goodell, president of the Dayton Section. Adresses were presented by George N. Shuster, president of Hunter College, New York City; Merle P. Smith, Dayton, Ohio, city commissioner; Prof. Edmund B. O'Leary, and others.

N.G. NEARE'S
Column

R. Robinson Rowe, M. ASCE

"OUR THEME TONIGHT," declared the Professor, "is probability. Probably the lesson would have a more fitting moral if our game of chance was a slot machine, but pitching pennies at a cuspidor can be just as tantalizing. Probably, also, Joe Kerr thinks he has mastered the game."

"'Probably' is right," admitted Joe. "Since Abe, Ben and Cal each made 210 pitches and won once in 5, 6 and 7 pitches, respectively, the number of winning pitches was 42 + 35 + 30 = 107, worth a total of 630 pennies. Prorating, Abe took 247 for a net gain of 37; added to his initial 50, he had 87 at the end. Similarly, Ben had 46 and poor Cal only 17. Easy, wasn't it?"

"Could be easier," sniekered Ken Bridgewater. "Noah said only that the successful pitcher took the contents of the cuspidor, which would be the penny just pitched. So he won nothing and each had his initial 50 pennies at the end!"

"I thot so too," claimed Cal Klater, "but I couldn't resist the implied problem if the winner gathered up the pennies on the floor, because it isn't the simple prorate that Joe used. On his first pitch, Abe probably wins $\frac{1}{5}$ and leaves $\frac{4}{5}$; then Ben has $\frac{1}{6}$ of a chance of winning $\frac{9}{5}$, or a probability of 0.3. A table of the first two and last rounds looks like this:

Round	Man	Wins	Leaves
1	Abe	0.200	0.800
1	Ben	0.300	1.500
1	Cal	0.357	2.143
2	Abe	0.629	2.514
2	Ben	0.586	2.928
2	Cal	0.561	3.367
210	Abe	1.200	4.800
210	Ben	0.967	4.833
210	Cal	0.833	5.000

"Formulating this, the pot left at the end of the nth round is $5\left[1-\left(\frac{4}{7}\right)^n\right]$, so that Abe, adding one and taking a fifth of the sum gets $1.2-\left(\frac{4}{7}\right)^n$. In the 210 rounds he will probably get the sum of 210 such amounts with n varying by units from 0 to 209, that is, $210 \times 1.2 - \sum_{n=0}^{209}\left(\frac{4}{7}\right)^n = 252 - s$, where the sum $s = \frac{7}{3}\left[1-\left(\frac{4}{7}\right)^{210}\right]$. Nearly enuf, $s = \frac{7}{3}$, so Abe probably takes $249\frac{2}{3}$.

"Similarly Ben gets $\frac{29}{30}-\frac{2}{3}\left(\frac{4}{7}\right)^n$ each time for a total of $203-\frac{2}{3}s = 201\frac{4}{9}$ and Cal $\frac{5}{6}-\frac{10}{21}\left(\frac{4}{7}\right)^n$ each time for $173\frac{8}{9}$. The three of them take 625, leaving 5 in the pot. Practically the probabilities have to be adjusted to the nearest penny, after which we find that they had at the end: Abe, 90; Ben, 41; Cal 14, or 92, 43 and 15 if they divided the pot."

"Which they would unless the cops broke up the game," said Professor Neare. "Now, continuing our theme of probability, Guest Professor Stoop Nagle will try to confuse you."

"It will also," promised Professor Nagle, "sound easy, look hard, solve easily. A field party, holed up by rain, was kept busy computing areas of cross-sections. Rodney computed 240 areas and Chaney, checking them, marked 56 'wrong.' Copney, the chief, had expected 48, because, on the average, Rodney erred on $^1/_4$ of his areas and Chaney found only $\frac{4}{5}$ of his mistakes. How many mistakes did Rodney probably make?"

[Kens and Cals were: Richard Jenney, Van Masce (J. S. Kendrick), Stoop (John L.) Nagle, George B. Richardson, Thatchrite (Guy C. Thatcher), Eepee (E. P. Goodrich), Anne Othernut (J. Charles Rathbun), Max L. Button and Marvin A. Larson. Also acknowledged are solutions to April's 11-14-19 problem from Anne Othernut and Uppan Atom (Count Harvey), left behind when the column had to be written on a field trip.]

Gunvald Aus (M. '95) former president of the Gunvald Aus Co., a New York City consulting structural firm, died in Oslo, Norway, on May 26, the eve of his eighty-ninth birthday. He had been living in his native country since his retirement in 1915. A graduate of Heidelberg University in Germany, he came to this country in 1892 and later was chief engineer in the office of the supervising architect of the U.S. Treasury Department. In 1902 Mr. Aus established his own firm, which designed the structural steel for numerous skyscrapers including the Woolworth and New York Life buildings.

Alexander James Barclay (M. '15) consulting engineer of Berkeley, Calif., died there on May 24, at the age of 79. Mr. Barclay had been with the New York Board of Water Supply on early construction work and was engaged on numerous California projects. For a number of years he was with the Southern Pacific Co., which he served as construction division engineer at San Francisco and in other capacities.

H. O. Christiani

Henning Oldenburg Christiani (Assoc. M. '41) president of the New York firm of Christiani & Nielsen, was killed in an automobile accident in France on May 25, at the age of 38. His home was in Scarsdale, N.Y. A Dane by birth, Mr. Christiani was educated at the Polytechnical University in Copenhagen. In 1936 he came to the United States for work on the New York World's Fair, and later was consulting engineer to the City of New Haven. From 1938 until the Nazi invasion of Denmark he was in the Copenhagen head office of Christiani & Nielsen, an international engineering firm founded by his father. He then established a wartime central office in New York for the firm's work in allied countries. During the war Mr. Christiani was also on the Fort Belvoir staff of the Corps of Engineers.

Norman Foster (M. '45) consulting engineer and member of the consulting civil engineering firm of Damon & Foster, Sharon Hill, Pa., died in Chester, Pa., on May 5. He was 61. His firm, which was formed in 1922, is engineering consultant to numerous municipalities in the Philadelphia area.

Merrill Anthony Gerstner (Assoc. M. '41) engineer for the New Orleans firm of G. A. Heft & Co., died suddenly at his home in that city on May 27. He was 41 and a graduate of Tulane University. Mr. Gerstner served his firm as resident engineer on the Elysian Fields overpass, and had been working on various problems of design and construction in connection with the new Union Passenger Terminal project. He was prominent in church work and held numerous offices in the Gulf district of the Lutheran Laymen's League.

Pareja Enrique Gongora (M. '47) director of the industrial relations department of the Cerro de Pasco Copper Corp., Oroya, Peru, died on October 24, 1949, according to word just received at Society Headquarters. He was 49. A civil engineering graduate of the Escuela de Ingenieros de Lima, Mr. Gongora had spent some years with the Peruvian government as resident engineer on numerous irrigation, hydraulic, and other construction projects. He had also been chief engineer of the Irrigation Section of the Water Department.

Henry Hugo Kranz (M. '31) city engineer of Cincinnati, Ohio, died suddenly there on June 10, at the age of 63. A civil engineering graduate of the University of Cincinnati, Mr. Kranz served as a captain in the AEF in France from 1917 through 1919, and returned to hold a number of jobs in private industry before joining the City of Cincinnati in 1926. He had been superintendent of highway maintenance, engineer of highways, and then city engineer. Prominent in the activities of the American Road Builders Association, Mr. Kranz was serving his second term as president of the Municipal Division of the organization at the time of his death.

Hugh Browning Holmes (M. '20) retired chief engineer of the Georgia & Florida Railroad, Evans, Ga., died in a hospital in Augusta, Ga., on June 1. He was 75. Mr. Holmes began his career with the Chicago, Burlington & Quincy Railroad in 1899, and from 1926 until his retirement in 1943 was chief engineer for the Georgia & Florida Railroad at Augusta, in charge of all maintenance and construction between Augusta and Greenwood, S.C. He was a life member of ASCE and the American Railway Engineering Association.

Frederick Edgar Morrow (Assoc. M. '30) retired engineer of Oak Park, Ill., died there on April 29, at the age of 69. From 1910 until his retirement in 1948, Mr. Morrow was chief engineer of the Chicago & Western Indiana Railroad and the Belt Railway Co., Chicago. Active in the American Railway Engineering Association, he had served terms as director and vice-president, and was president in 1938. He was a graduate of Purdue University.

Clyde Potts (M. '10) retired consulting engineer of New York City, died at his home in Morristown, N.J., on May 19, at the age of 74. Mr. Potts' experience covered the period of the greatest development in sanitary engineering. A graduate of Cornell University, class of 1901, Mr. Potts designed water supply and treatment works for many New Jersey and New York communities, and aided in the development of additional sources of supply for New Jersey. He was a member of the New Jersey State Department of Health for 25 years and president for six terms, and worked for the establishment of the Child Hygiene Bureau in the department. Long active in community affairs, he was mayor of Morristown for 13 two-year terms.

Clyde Potts

Harry Albert Schmitt (Assoc. M. '43) village manager and engineer of Shorewood, Wis., died on April 28, at the age of 47. A civil engineering graduate of Marquette University, Mr. Schmitt had been in the engineering service of Shorewood since 1921. During the war he served in England, France and Sicily, and was discharged with the rank of major.

Frank Harold Shaw (M. '16) consulting engineer of Lancaster, Pa., died in a hospital in West Chester, Pa., on May 13, at the age of 78. Mr. Shaw had been city water superintendent for about eight years and county engineer for Lancaster County. In addition to work on the Lancaster sewerage system, Mr. Shaw rebuilt the Elmira, N.Y., water system and was instrumental in construction of the Reading water supply.

Frederick Van Antwerp (Assoc. M. '38) civil engineer of Seattle, Wash., died in a hospital there on April 28, at the age of 64. An alumnus of Michigan State College, Mr. Van Antwerp had worked on construction of the Lake Washington Pontoon Bridge and other projects in the Seattle area. He had also been with the British Columbia Bridge & Dredging Co., at Prince Rupert, B.C. He was a veteran of World War I, and had been prominent in Masonic activities.

Walter Charles Youngs (M. '23) died at his home in Atlanta, Tex., on February 20, at the age of 74. He was an alumnus of Louisiana State University. Mr. Youngs had a distinguished career in the transportation field in the Southwest, beginning with bridge construction on the Missouri River in 1900, followed by railroad construction in Oklahoma, Louisiana, and Texas. After ten years as consulting engineer in Jackson County, Texas, he served for five years as county engineer for Polk and Liberty counties, developing their highway systems. From 1927 to 1949 he was engaged in highway construction in Louisiana, retiring in the latter year as district engineer for the Louisiana Highway Commission at New Orleans.

NEWS OF Engineers

Forest H. Green, research engineer of the Joint Highway Research Project at Purdue University, has been granted a leave of absence to accept a temporary appointment from the State Department as visiting specialist in highway engineering to the Egyptian government. Professor Green will advise on materials, machinery, and methods of rehabilitation.

Perry T. Coons was recently appointed assistant to vice-president—sales of the American Steel & Wire Co., of Cleveland, Ohio, a U.S. Steel subsidiary. He has been on the organization's staff for 40 years.

Fred C. Schlemmer has resigned as Hanford, Wash., operations manager for the U.S. Atomic Energy Commission, to join a construction and engineering firm in New York City.

James K. Finch, since 1946 dean of the school of engineering at Columbia University, has retired. Dr. John R. Dunning, professor of physics and director of the cyclotron at Irvington-on-Hudson, N.Y., is his successor. Dean Finch, who began his teaching career at Columbia in 1911, will be retained in the capacity of Renwick Professor of Civil Engineering. He is the author of numerous papers on engineering education. From 1936 to 1938 he served the Society as a Director.

James K. Finch

Jesse L. Tygart, formerly construction engineer with the Plaskon Division of Libbey-Owens-Ford Glass Co., of Toledo, Ohio, has become connected with Paul R. Jeffers, Inc., heavy construction and earthmoving contractors, as chief engineer.

Mohawk-Hudson Local Section members, together with other engineers and educators in the area, held a testimonial dinner in honor of **Warren C. Taylor,** who retired recently as professor and head of the civil engineering department at Union College.

Bruce G. Johnston has accepted an appointment as professor of structural engineering in the department of civil engineering of the college of engineering at the University of Michigan. Since 1927 Dr. Johnson has served as professor of structural engineering at Lehigh University, and in 1947 became director of the Fritz Engineering Laboratory at the university. While on leave of absence from Lehigh University from 1942 to 1945, he served as a structural engineer with the Bureau of Yards & Docks and as senior engineer and project supervisor of the Applied Physics Laboratory at Johns Hopkins University. He was awarded the James R. Croes Medal in 1937.

Bruce G. Johnston

(Continued on page 65)

(Continued from page 64)

Harold B. Gotaas, professor of sanitary engineering and chairman of the division of civil engineering, University of California, has gone to Europe for the World Health Organization to observe engineering and sanitary projects and discuss engineering and sanitation in the United States with engineering and public health institutions in ten countries of Western Europe.

Edward J. Quirin has been elected president of Frederic R. Harris, Inc., consulting engineers of New York City and San Francisco, Calif., succeeding the late **Rear Admiral Frederic R. Harris,** CEC, USN (Retired). Mr. Quirin, who has been associated with the organization for the past 11 years, recently served as vice-president.

Charles Wilkie has joined the sales engineering staff of Sika Chemical Corp., with headquarters in Passaic, N.J. Previously, Mr. Wilkie was connected with the H. K. Ferguson Co., Inc., as project engineer in the atomic energy division.

C. F. Zeigler is now vice-president and manager of E. W. Geiger, Inc., of Topeka, Kans., successor firm to Geiger & Rutherford, of Leavenworth, Kans.

Charles B. Stanton, professor of civil engineering and assistant to the president at Carnegie Institute of Technology, has retired. Since 1911 a member of the CIT faculty, Professor Stanton has also been affiliated with the firm of Hunting, Davis & Dunnels, Engineers and Architects, for the past 20 years. He is a past-president of the Pittsburgh Section of the Society.

Willard S. Conlon, formerly consulting engineer at Dallas, Tex., has been named purchasing agent and city engineer of the recently created Purchasing Department of Greenville, Tex.

A. C. Northover has been appointed resident engineer for McKim Township, Sudbury, Ontario. Mr. Northover has served as municipal engineer of Midland, Ontario, since 1947.

Named as consultants on the $208,000,000 Central and Southern Florida Flood Control Project are **ASCE Director Edmund Friedman,** of Miami, and **Honorary Member Boris A. Bakhmeteff,** professor of civil engineering at Columbia University.

Charles F. Bird and **Albert M. Tietzel** announce the formation of a partnership under the firm name of Bird & Tietzel for the practice of consulting engineering at Columbus, Ohio.

George H. Buck, senior member of the consulting engineering concern of Buck, Seifert & Jost, of New York City, has been elected president and director of the Hackensack Water Co., succeeding Henry L. deForest.

William P. Cornelius, previously chief of the construction and maintenance division at the Hanford Works of the U.S. Atomic Energy Commission, has been appointed manager of the new Houston, Tex., district office of Giffels & Vallet, Inc., & L. Rossetti, Associated Engineers and Architects, of Detroit, Mich.

Robert C. Cutting has retired as civil engineer with the New Orleans, La., District of the Corps of Engineers after 45 years of service. Mr. Cutting began his career as a junior engineer in the Pittsburgh District in 1905. In 1914 he was engaged by the Australian government as construction engineer on a waterways structure project, and also served in Europe as a consultant. His work in the New Orleans District has embraced all phases of investigations and channel improvements on the lower Mississippi River.

Hardy S. Ferguson has joined the pulp and paper engineering division of the H. K. Ferguson Co., industrial engineers and builders of New York, as consultant. He recently dissolved his own engineering concern, Hardy S. Ferguson, Engineers.

Richard K. Hale, since 1919 associate commissioner of waters in the Massachusetts Public Works Department, has retired. An authority on flood control and beach erosion, Mr. Hale has supervised the planning and building of numerous state projects.

PERSONNEL OF METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, include (left to right) Robert B. Diemer, M. ASCE, recently appointed to newly created office of assistant general manager and chief engineer; James M. Gaylord, who is retiring as chief electrical engineer; and Robert M. Peabody, M. ASCE, who succeeds Mr. Gaylord. In addition to his new responsibilities as principal assistant to General Manager and Chief Engineer Julian Hinds, Mr. Diemer will continue to perform his duties as chief operation and maintenance engineer of Colorado River Aqueduct System.

Robert E. Stiemke

Robert E. Stiemke, for the past three years professor of sanitary engineering at Pennsylvania State College, will assume new responsibilities as director of the school of engineering at Georgia Institute of Technology on September 1. During the recent war he served as associate professor of sanitary engineering at North Carolina State College and as director of the college's Engineering Experiment Station, in addition to assisting with the Army specialized training program. He is the author of articles on stream pollution and flow of water.

Herbert T. Knapp announces the opening of a consulting office under the firm name of Herbert T. Knapp & Associates, engineers, at 1028 Falls Building, Memphis, Tenn.

Harold A. Thomas has retired as professor of civil engineering at Carnegie Institute of Technology after 27 years of service. He was guest of honor at a recent testimonial dinner given by his friends and colleagues.

John G. Hendrickson has become affiliated with the American Concrete Pipe Association and the American Concrete Pressure Pipe Association as research engineer, with headquarters in Chicago, Ill. Previously, Mr. Hendrickson was on the faculty of Princeton University.

William B. Bennett, vice-president and secretary of the Capital Transit Co., Washington, D.C., has retired after 17 years of service.

Frederick H. Zurmuhlen, commissioner of public works, New York City, has accepted the chairmanship of the 1950 Public Works Congress and equipment show, to be held in New York, October 15–18, under sponsorship of the American Public Works Association.

Frederic H. Kellogg is now dean of the school of engineering at the University of Mississippi, succeeding **Lee Johnson,** who has accepted the deanship of Tulane University College of Engineering. Dr. Kellogg recently returned from India, where he was an adviser to the Westinghouse International Electric Co. on dam construction work near Simla.

Hibbert M. Hill, hydraulic engineer, Northwest States Power Co., of Minneapolis, Minn., has been appointed to the Engineering Council for Professional Development's Committee on Professional Training, to fill the unexpired term of the late **Jacob E. Warnock.**

W. B. Hovey has established the firm of Hovey Concrete Products Co., with offices at Santa Fe, N.Mex. Mr. Hovey was formerly associated with Creole Petroleum Corp., of Caracus, Venez. **M. R. Adler,** who has been with the University of Nebraska, will assist him.

(Continued on page 66)

(Continued from page 65)

Lewis J. Workman, on the Bureau of Reclamation staff at Amarillo, Tex., has gone to Juneau, Alaska, where he will work on water resources development investigations. Mr. Workman has been with the Bureau since 1930, except for a short leave of absence (1944 and 1945) when he acted as consulting engineer to a South American firm.

Lewis J. Workman

Morris Goodkind, ASCE Director and New Jersey State Highway Department bridge engineer, received an honorary doctor of engineering degree from Newark College of Engineering during the recent commencement exercises. He was also feted at a recent testimonial dinner given by the Highway Department in recognition of his 25 years of service.

Philip B. Fleming, major general, Corps of Engineers, Department of Army, has been named by President Truman as Under Secretary of Commerce for Transportation. In this capacity, General Fleming will preside over transportation programs and policies of the government. Administrator of the Federal Works Agency from 1941 to 1949, General Fleming recently has been serving as head of the U.S. Maritime Commission.

Louis J. Rumaggi, colonel, Corps of Engineers, who has been district engineer of the Detroit, Mich., District, has assumed new duties as district engineer in the New York Headquarters of the First Army.

George E. Shafer has been appointed chief engineer of Armco Drainage and Metal Products, Inc., Middletown, Ohio. In addition, he will have charge of the product engineering and new product development departments.

Wendell C. Sorensen has become an associate in the firm of Nield-Somdal Associates, architects and engineers, of Shreveport, La. This concern succeeds that of Nield & Somdal, of the same city.

PRESIDENT TRUMAN pins Department of Interior award for distinguished service on Frank A. Banks, district manager, Bureau of Reclamation at Grand Coulee Dam

New Publications

Public Speaking. A helpful, pocket-size, paper-bound booklet, entitled *Speaking Can Be Easy—for Engineers*, has been prepared to meet professional needs by the Committee on Relations with Industry of the American Society for Engineering Education, headed by E. C. Koerper. The booklet sells at 50 cents a copy from the Engineers Council for Professional Development, 33 West 39th Street, New York 18, N.Y.

Speaking Can Be Easy

Advanced Study in Transportation. Opportunities for advanced engineering students to undertake college study in transportation and traffic, particularly at the graduate level, are described in a booklet just published by the Institute of Transportation and Traffic Engineering at the University of California. Copies may be obtained from the Director of the Institute, University of California, Berkeley 4, Calif.

Government Standards. In answer to inquiries concerning the scope of its testing program, the National Bureau of Standards has issued Circular C483, which fully describes its test policy, presents general information on testing, and lists fees. The 93-page publication, which is entitled *Testing by the National Bureau of Standards*, may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 25 cents a copy.

Tidal Hydraulics. An evaluation of present knowledge of factors affecting tidal hydraulics and related phenomena comprises Report No. 1 of the Committee on Tidal Hydraulics of the Army Corps of Engineers. In the belief that there is a large fund of unpublished knowledge on subjects discussed in the report, the Committee invites readers to comment on the report and contribute pertinent data. If the response warrants, discussions and contributions will be published as a supplementary volume. Comments should be addressed to the Chairman, Committee on Tidal Hydraulics, Philadelphia District, Corps of Engineers, P.O. Box 8629, 121 N. Broad Street, Philadelphia 1, Pa. Copies of the report are obtainable from the Recorder, Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss., at $1 each.

Highways. Highway progress made in Virginia during the fiscal year ending June 30, 1949, is detailed in the 42nd annual report of the commission to the Governor of Virginia. Also included in the 114-page brochure are division reports and a summary of progress on the 20-year plan. Inquiries concerning the graphically illustrated volume should be addressed to the State Highway Commission, Division of Purchase and Printing, Richmond, Va.

Weather and Building. Proceedings of the research correlation Conference on Weather and the Building Industry, sponsored by the Building Research Advisory Board of the National Research Council, are now available from the Board at 2101 Constitution Avenue, Washington 25, D.C. The papers comprising the 100-page illustrated volume give a picture of what is known about climatology today and its relationship to the building industry. Single copies sell for $3.50, with special rates of $2.50 a copy available for quantity orders of from ten to twenty, and of $2 for lots of twenty and over.

Highway Personnel. The names, positions, and addresses of highway officials and engineers of the 48 state highway departments, the District of Columbia, and the Bureau of Public Roads are listed in a 60-page booklet recently made available by the American Road Builders' Association. Copies sell for $1 each upon application to the ARBA, International Building, Washington 4, D.C.

Fatigue Testing. Findings and conclusions of the American Society for Testing Materials Committee E-9 on Fatigue are reported in a new ASTM Manual on Fatigue Testing. Issued as Special Technical Publication No. 91, the 88-page manual can be purchased from the ASTM, 1916 Race Street, Philadelphia 3, Pa., at $2.50 a copy in heavy paper binding and for $3.15 in cloth.

Research. Engineering and other research work, conducted at the Stanford Research Institute during 1949 is summarized in the 1949 Annual Report of the Institute. Now in its third year of operation, the Institute reports that its research activity is now at the annual rate of $2,000,000, and that the 1949 volume of industry and government-sponsored research almost tripled that of the preceding year. Current projects include research in smog and land subsidence in the Long Beach–San Pedro area and geophysical explorations.

Highway Safety. Street and highway accident data for the past year are graphically presented in a booklet entitled *Main Street*, which is being distributed free in the interest of street and highway safety by the Travelers Insurance Companies, Hartford, Conn. According to the firm, which maintains a statistical bureau for collection and analysis of accident data from all the states, excessive speed headed the list of causes of accidents in 1949.

Wood Preservation. Publication of *Preliminary Wood Preservation Statistics* for 1949 is announced by the Division of Forest Economics of the U.S. Forest Service. Figures in the current statistical series, which is issued in cooperation with the American Wood-Preservers' Association, are based on reports from 270 plants representing more than 95 percent of the wood-treating capacity in the United States. Copies of the report may be obtained from the U.S. Forest Service, Washington 25, D.C.

(Continued on page 68)

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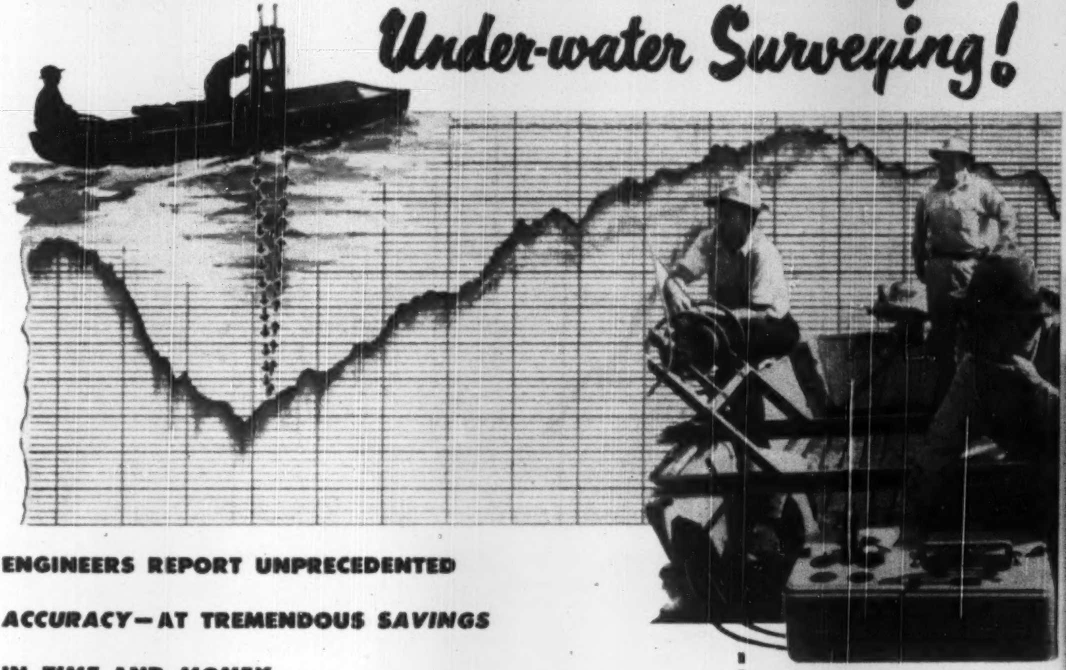
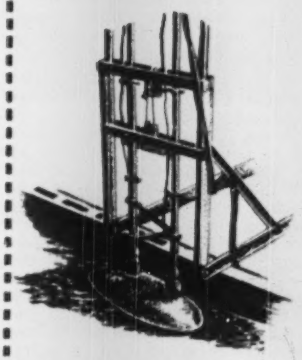


ENGINEERS REPORT UNPRECEDENTED ACCURACY—AT TREMENDOUS SAVINGS IN *TIME* AND *MONEY*...

Typical of the engineer's search for improved methods and techniques is his recent application of electronics to subaqueous explorations. By employing supersonic pressure waves, precision timing and monochromatic recording, he obtains a continuous underwater profile view. Simultaneously, he determines river-bottom composition—rock, silt, etc. Bludworth Marine, a pioneer in the development of precision electronic sounding equipment, has made available to commercial engineers, industries and construction firms, the *model E.S. 123 Portable Precision Recorder*. Many of these instruments are already in service, and owners report tremendous savings in time and money. For example, the Missouri Pacific Railroad has cut by 40-50% the time required to make periodic surveys along its lines at bridges and ferry crossings.



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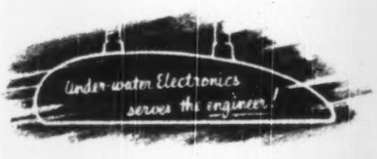

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(Continued from page 66)

Concrete Research. Investigations of the effect of sand grading on the properties of mass concrete, conducted by the Concrete Research Division of the Waterways Experiment Station, are described in Technical Memorandum No. 6-307, recently announced by the Army Corps of Engineers. Copies may be purchased from the Waterways Experiment Station, Vicksburg, Miss., at 75 cents each.

Sanitary Engineering. To assist the military establishment in solving some of the problems encountered at military bases in low-temperature areas, the Committee on Sanitary Engineering and Environment of the National Research Council has made available a report of its Subcommittee on Waste Disposal. Inquiries concerning the report, which is entitled *Sewage Pumping Stations for Low Temperature Conditions*, should be sent to Division of Medical Sciences of the National Research Council, 2101 Constitution Avenue, Washington 25, D.C.

City Planning. An address on the development and planning of American cities, delivered by Harland Bartholomew, M. ASCE, St. Louis city planner, at Carnegie Institute of Technology on May 10, has been issued as No. 1 in a new series designated Carnegie Press Occasional Papers. Inquiries should be addressed to Carnegie Institute of Technology, Pittsburgh, Pa.

Steel Research. Basic information on the major steel products is presented by the American Iron and Steel Institute in Section 24 of its Steel Products Manual, which is being issued in installments. Copies of Section 24, dealing with stainless and heat-resisting steels, can be purchased from the Institute at 350 Fifth Avenue, New York 1, N.Y., at 25 cents each postpaid.

Airport Design. Principles involved in the planning and design of airports, as well as related problems and standards of design, are set forth by Robert Horonjeff, Assoc. M. ASCE, and John Hugh Jones, Jun. M. ASCE, in University of California Syllabus No. 316, a recent release of the University of California Press. Chapter headings are: Site Selection; Airport Design Standards; Layout of Airports; Pavement Design; Airfield Drainage; and Airport Marking and Lighting. The 64-page illustrated publication may be purchased at the Associated Students' Store of the University of California, Berkeley 4, Calif., at $1.50.

Beach Study. The effect of spring tides, high waves, and direction of the longshore transport of sand on the stability of the spits bordering Mugu Lagoon, California, is discussed in Technical Memorandum No. 14 of the Beach Erosion Board. Inquiries regarding the report, which was prepared by D. L. Inman, of the Scripps Institute of Oceanography, should be addressed to the Beach Erosion Board, Corps of Engineers, Washington, D.C. Technical Memorandum No. 15, prepared by Dr. Francis P. Shepard, of the Scripps Institute and dealing with *Longshore-Bars and Longshore Troughs*, is available from the same source.

Electrical Measurement. The theory, development, and verification of an electrical instrument for measuring the air concentration in flowing air-water mixtures comprise Technical Paper No. 2, Series B of the St. Anthony Falls Hydraulic Laboratory. Authors are Owen P. Lamb and John M. Killen. Requests for copies, priced at 50 cents each, should be addressed to the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

Engineering Tables. Availability of a new volume of *Tables of the Binomial Probability Distribution*, which is both convenient to use and of sufficient scope, accuracy, and detail for many varied practical applications, is announced by the National Bureau of Standards. Originally prepared for limited distribution by the Department of the Army, the tables have been rearranged and published by the Bureau of Standards as Applied Mathematics Series No. 6. The 387-page, buckram-bound volume is available from the Superintendent of Documents, U.S. Government Printing Office, at $2.50 a copy. Remittances from foreign countries must be in United States exchange and should include an additional sum of one-third the publication price to cover mailing costs.

Columbia Basin. As an aid to present land owners and prospective settlers in the Columbia Basin area in Washington, Fred M. Berry, Assoc. M. ASCE, of Ephrata, Wash., has compiled a map of the Columbia Basin Project. Drawn to a scale of 5,000 ft to 1 in., the map gives complete land information on irrigable and non-irrigable acreage, and shows railroads, highways, towns, dams, proposed canals, and other landmarks. Data presented are developed from topographic and classification surveys made by the Bureau of Reclamation, the U.S. Geological Survey, railroads, the state, and counties. Copies, priced at $1, may be obtained from Mr. Berry.

United Nations. Issuance of a monthly index to United Nations publications is announced by the U.N. Entitled *Documents and Publications of the United Nations and Specialized Agencies*, the photo-offset publication will range between 75 and 100 pages. The annual subscription will be $7.50 post-free, and orders may be sent to the Sales and Circulation Section of the United Nations, Lake Success, N.Y., or to the Sales Section, European Office of the United Nations, Palais des Nations, Geneva, Switzerland.

Refresher Texts, New York. Recent refresher texts of past examinations for Professional Engineer and Engineer-in-Training in New York State include solutions to Part I problems, entitled "Structural Planning and Design." The text, priced at $3, may be obtained from William Glendinning, 5123 Bell Blvd., Bayside, N.Y. Mr. Glendinning has also assembled solutions to problems in Basic Engineering Sciences from Part II of the New York State examinations, which sell for $3, and from Part III, entitled "Engineering Economics and Practice," which is similarly priced. Refresher notes on the Professional Engineer License examination in hydraulics, thermodynamics, and machine design—written and published by John D. Constance, Hudson Terrace, Cliffside Park, N.J.—were revised in 1949. The text is priced at $4.50. Mr. Constance has also assembled solutions to Part II problems in the Basic Engineering Sciences from examinations for P.E. license, given in February and June 1947, February and July 1948, and May 1949. The complete set of five is $1.50 postpaid, and single examinations are 50 cents each. A set of the last twelve complete examinations for professional license (without solutions) may be obtained from the Education Committee of the Metropolitan Section of the ASME, 29 West 39th Street, New York 18, N.Y., at 50 cents.

Highway Stabilization. Issuance of a new section of Standard Specifications for Public Works Construction, prepared by the 1949 Committee on Stabilized Roads of the American Public Works Association, is announced by the APWA. The present publication, consisting of a standard specification for soil cement roads and streets and designated Section H, sells for $1, upon application to the APWA, 1313 East 60th Street, Chicago 37, Ill. A 40 percent discount is available to APWA members.

Safety Directory. The entire field of safety products, including fire protection and control, sanitation, and construction equipment, is covered in *Best's Safety Directory* for 1950-1951. Copies, priced at $5 (with lower rates for quantity orders) may be obtained from the home office of the Alfred M. Best Co., 75 Fulton Street, New York 7, N.Y., or branch offices in Atlanta, Boston, Chattanooga, Chicago, Cincinnati, Dallas, and Los Angeles.

British Manufacturers. The 1949–1950 edition of the *FBI Register of British Manufacturers*, published annually for the Federation of British Industries, is available from the publisher, Kelly's Directories Ltd. and Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. An authoritative guide to British sources of supply, the 807-page volume lists nearly 6,000 firms and their products. The price of 42*s* includes postage.

Mississippi River Control. Detailed data on stages and discharges of the Mississippi River and its tributaries for 1947, ascertained at stations operated by the Corps of Engineers, have been compiled in a 322-page, paper-bound bulletin. The volume sells for $1, upon application to the Office of the President, Mississippi River Commission, Vicksburg, Miss.

Rubber. Postwar applications of natural rubber in engineering and industry are re-

(Continued on page 73)

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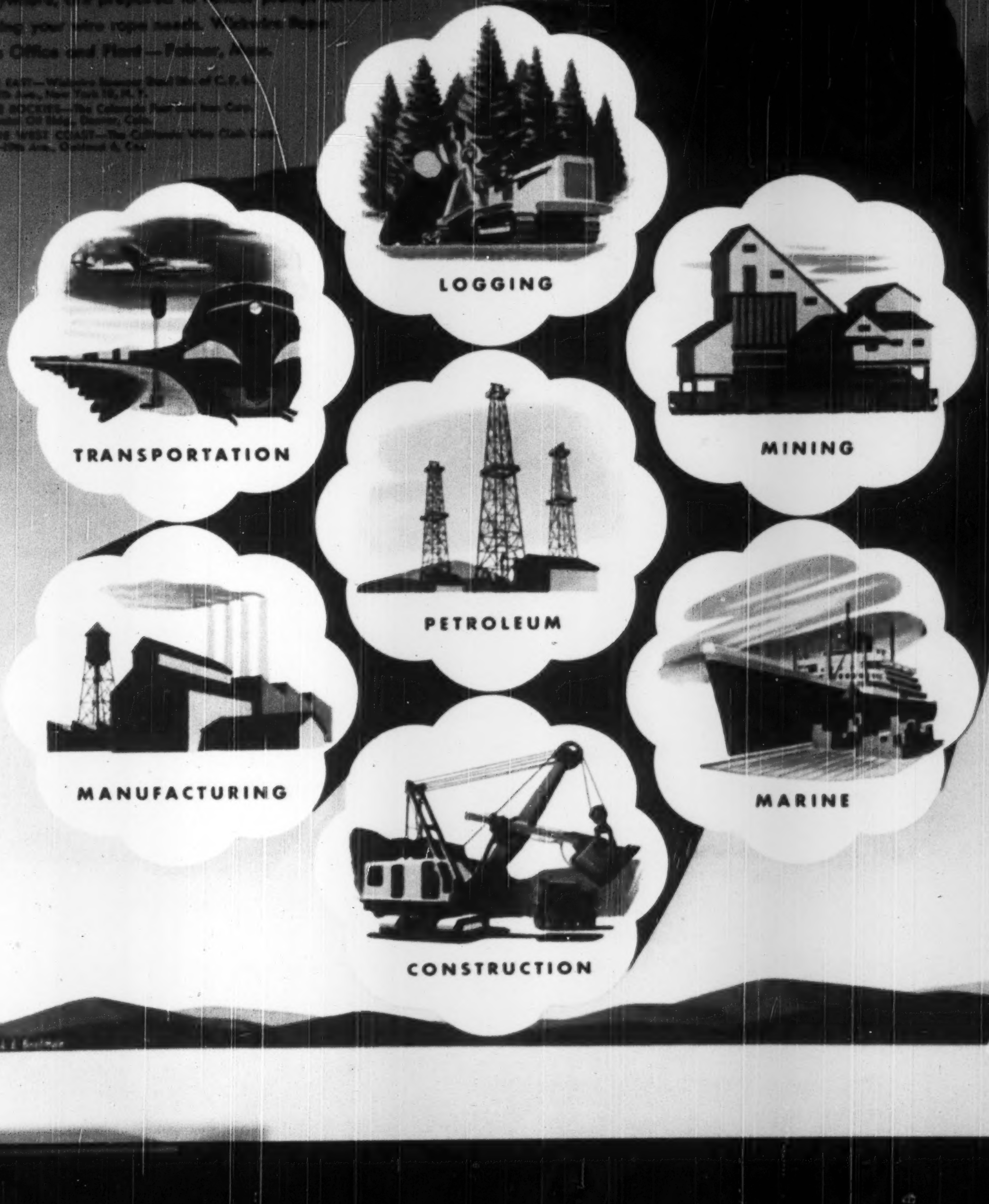
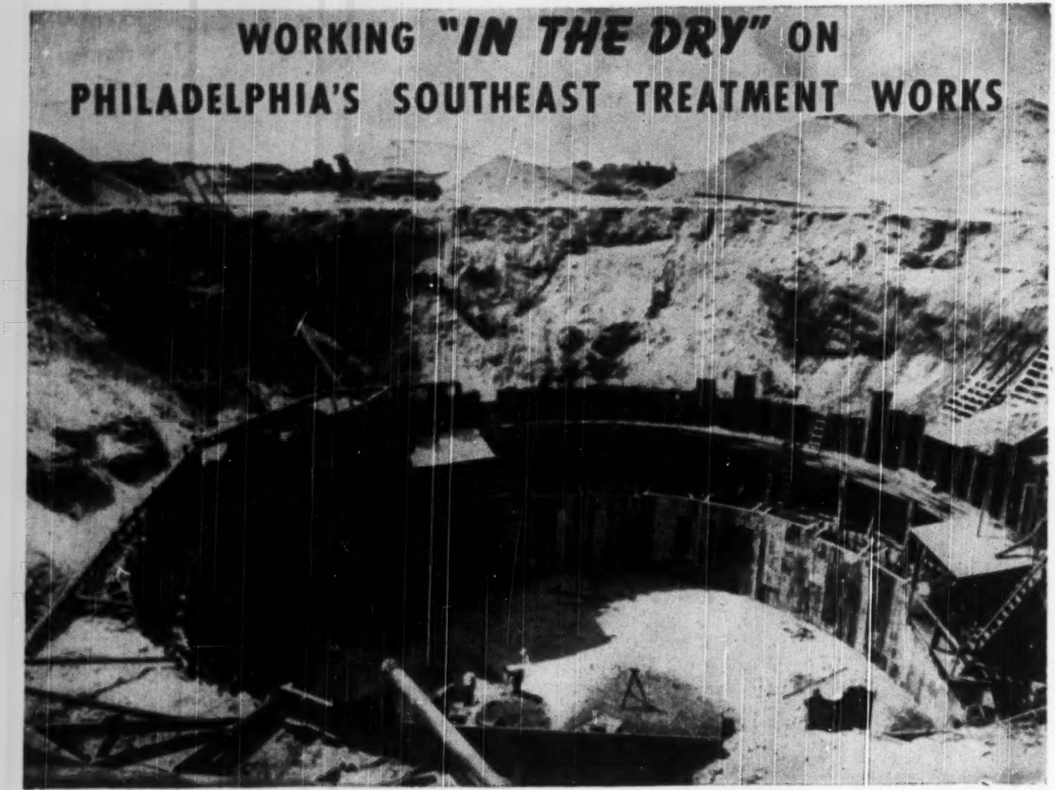


WORKING *"IN THE DRY"* ON PHILADELPHIA'S SOUTHEAST TREATMENT WORKS



Moretrench Wellpoints control 23 feet of water on this pump station. Laminated wood whalers eliminate need for cross bracing. Contractor: Virginia Engineering Co., Inc., Newport News, Virginia.

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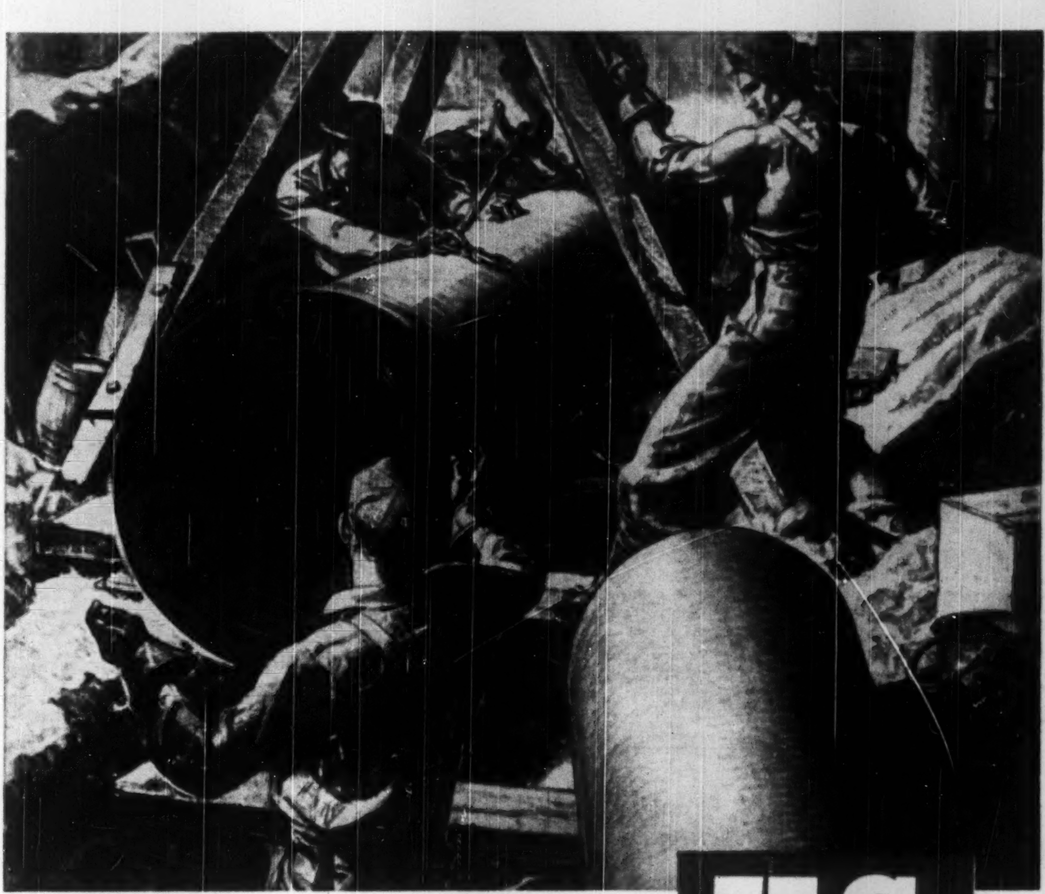

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PROFESSOR CIVIL ENGINEERING, Assoc. M. ASCE; 36; married, 2 children; registered engineer Colorado and Wisconsin; practical, research, college, undergraduate and graduate university experience. Now teaching structural engineering as associate professor in state university. Interested in permanent position as professor, associate professor, or department head. C-610.

ENGINEER, M. ASCE, licensed P.E.; graduate; 26 years' local experience in structural design of buildings, bridges, and hydraulics. Desires responsible position in New York City. C-611.

SANITARY ENGINEER, Jun. M. ASCE; 29; veteran; 4 years' experience all phases of sanitary engineering—United States and overseas—industry and government. Desires position in technical sales or field engineering, United States or overseas; willing to travel. C-612.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

HYDRAULIC ENGINEER-HYDROLOGIST, Jun. M. ASCE; M.S. in C.E., Massachusetts Institute of Technology; married; veteran; 5 years' experience military weather forecasting, 2 years' river forecasting and hydrologic investigations. Desires position in meteorological-hydrologic investigations leading to hydraulic design. Desires East or Mid-west. Will travel occasionally. C-613.

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SALES MANAGER, under 50, civil graduate, with at least 5 years' experience as district or assistant district manager and 10 years' design and sales experience in fabricated steel construction, to supervise Mid-west sales activities for fabricator. Salary open. Location, Illinois. Y-3628-R-6509.

SENIOR STRUCTURAL DESIGNER with minimum of 10 years' experience in the design of steel and reinforced concrete, for industrial building and power station. Salary, $7,500 a year. Location, Connecticut. Y-3642.

INSTRUCTOR in civil engineering, master's degree desirable, to teach surveying, mechanics, structural analysis, and materials testing. Location, New England. Y-3653.

SALES ENGINEER, 25-30, mechanical or civil engineer with experience in concrete construction, to sell bulk materials handling equipment, concrete mixers, scales, etc., for the construction industry. Location, Pittsburgh district. Y-3666.

ASSOCIATE PROFESSOR in civil engineering, 35-45, master's degree with teaching experience and at least 5 years' experience in irrigation engineering, to supervise graduate program. Salary, $4,500 a year. Location, West. Y-3669S.

INSTRUCTOR OR ASSISTANT PROFESSOR to teach elementary, advanced and topographic sur-

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Major Oil Company in New York City requires experienced civil engineer and draftsman to design and detail miscellaneous structures. Good experience on piers and bulkheads essential. Field examinations and reports. Technical graduate not over 40. Permanency and advancement available to right man. Give full particulars on age, education, experience and salary expected.

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veying, railroad and highway engineering and engineering problems, and supervise highway materials testing laboratory. Salary, $2,700-$3,500 for nine months. Location, Southwest. Y-3681S.

Chief Planning Engineer, under 50, graduate, with special training in the field of city planning, and 5 years' professional city planning, experience, to be responsible to the city planning commission in originating, developing, and presenting to the council and the public the various phases of a master plan and direct the engineering, economic, and social research required for developing and maintaining such a plan. Salary, $7,200-$8,400 a year. Location, Pacific Northwest. Y-3690.

Civil Engineers, graduates, who have had experience in road construction for a road-building program in Venezuela. Mostly dirt road construction. Knowledge of Spanish desirable. Considerable traveling. Two-year contract, with two months' vacation a year. Salary open. Y-3710.

Technical Writer or Specification Writer for specification and instruction manual on heavy construction. Senior and junior classification. Salary, $6,480-$7,800 a year. Location, Washington state. Y-3711(*b*).

Staff Engineer, civil, 30-38, graduate, with 5 to 10 years' experience in construction, preferably in mass concrete and building. Sales promotion work. Salary open. Location, New York, N.Y. Y-3712(*b*).

Chief of Party, under 45, civil graduate, with considerable experience on railroad location work and general surveying experience, to take charge of field party. Salary, $7,200-$9,000 a year. Location, Venezuela. Y-3716.

Structural Designer, 30-45, degree in civil engineering. Must have had 7 to 10 years' experience in the design of ore bridges, coal unloaders, cranes, and/or other heavy materials handling equipment. Will plan sequences and prepare diagrams of erection procedure. Make design calculations and design estimates. Study requirements of the specification and determine and make records of the necessary primary design characteristics. Salary open. Location, Pennsylvania. Y-3725.

Engineers. (*a*) Field Engineer with experience on highway and railroad surveys, to do instrument work, etc. Salary, $4,800-$6,000 a year. (*b*) Engineering Draftsman with experience, to do topographic work. Salary, $3,900-$4,500 a year. Location, Labrador. Y-3727.

District Sales Manager, civil engineer or architect; age to 38; 5 years' experience with sales manager for manufacturer of building products. Aggressive personality to head up district office for manufacturer of metal building products such as store fronts, commercial entrances, facings, and aluminum awnings. Headquarters Minneapolis. Salary, $500 a month plus expenses, car and bonus. R-6480(*a*).

Field Engineers, (2), graduate mechanical, civil or structural engineers, 25-32, some experience in field supervision of trades on steel, concrete, tile and electrical equipment. Prefer knowledge or experience in installation of electrical precipitators or similar equipment. Salary, $325-$400 a month, plus expenses. Prefer resident of Chicago. R-6501.

Instructor, M.S. structural engineering. Teaching assignment principally structural engineering. Salary, $3,200 for nine months. Location, Middlewest. R-6506.

Architectural Engineer, 30, 4 or more years' experience with industrial buildings. Structural work, knowledge of canning, equipment installations. Informed about general construction; engage in general building from board through final construction; on industrial buildings, dealing with masonry, structural steel, and reinforced concrete, etc. For a packing company. Salary, $350-$400 a month. Location, Illinois. R-6507.

Engineers. (*a*) Project Division Manager, 40-45; direct designing engineering, construction, procurement and specialized cost control and analyses services required in study, acquisition and construction of insurance company's facilities such as residential, commercial, industrial, and rural properties and projects. Work covers all administration, control and supervision of own division as well as outside architects and contractors. Salary, $8,000-$12,000 a year. (*b*) Chief Architect. Will provide and supervise the general execution of all design and engineering services required in the study, acquisition and construction of an insurance company's facilities as shown above. Work covers planning, organization administration, coordination, control, and supervision of the department's projects. Salary, $8,000-$12,000 a year. (*c*) Project Superintendent—home office. B.S., 5 to 10 years' experience in building construction. Will coordinate construction activities in home office building, keep an accurate report on the distribution of time and progress, maintain completion dates, supervise operating personnel, contact necessary parties concerning construction program, keep labor and costs in line, and maintain progress reports. Should be able to handle own correspondence and be versed in large scale construction procedure. Salary, $4,000-$6,000 a year. (*d*) Project Superintendent, W.R.F.D., B.S., 5 to 10 years' experience in building construction. Will coordinate and supervise construction activities away from home office, keep an accurate report on the distribution of time and progress, maintain completion schedules, supervise operating personnel, contact necessary parties concerning construction program, keep labor and costs in line, and maintain progress reports. Salary, $4,000-$6,000 a year. (*e*) Design Engineer, sufficient to solve construction and operating problems. General building construction. Knowledge of architectural engineering and building, mechanical, electrical, and structural work. Will make design analyses and working drawings and layouts requiring major calculations and development of design on residential, commercial, industrial, and rural building projects. Solve specialized technical problems arising during design and construction. Salary, $5,000-$7,500 a year. Location, Ohio. R-6546.

(*Continued from page 68*)

viewed in two recent pamphlets, which are obtainable from the Natural Rubber Bureau, 1631 K Street, N.W., Washington 6, D.C. Use of rubber in the top surfacing of asphalt roads in the United States and Canada is reported in one of the publications, *Stretching Highway Dollars with Rubber Roads*, by Harry K. Fisher, highway consultant for the Natural Rubber Bureau. The other, entitled *Rubber Developments*, is a compendium of industrial uses issued by the British Rubber Development Board.

Highway Research. Committee personnel and other data on the organization and administration of the Highway Research Board are available in the current Yearbook of the Board. Inquiries should be addressed to the Board, National Research Council, Washington 25, D.C.

Compressed Air Handbook. A complete and authoritative reference book on compressed air power, issued by the Compressed Air and Gas Institute under the title, *Compressed Air Handbook*, covers applications, equipment, engineering data, and test procedures. Priced at $3 a copy for general distribution, the 400-page profusely illustrated handbook will be available to members of Student Chapters of the ASCE and AGC at the special price of $1.50. Students wishing copies should write to Edmond C. Powers, secretary, Committee on Engineering Education, Compressed Air and Gas Institute, 1410 Terminal Tower, Cleveland 13, Ohio.

Field Test Determines Foundation Modulus for Bayou Bodcan Dam

(*Continued from page 25*)

fore is not directly applicable. Otherwise the agreement between the modulus of elasticity as determined from laboratory and from field results is probably close enough so that the foundation modulus could have been computed from the laboratory tests to obtain a reasonably good approximate value. This would have been sufficiently accurate for practical purposes, since it enters into design calculations as the fourth root of its value.

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Engineering Is Both a Profession and a Business

(*Continued from page 50*)

office or a city engineer on salary. The distinguishing features of a profession are:

1. It involves, as Mr. Baker says, independent judgment based on the understanding of basic principles.
2. Its exercise inures to the benefit of mankind. How this benefit is made available need not change the classification of the benefit.

Exactly the same remarks which Mr. Baker applies to engineering could be applied to other professions. I know of one law office in San Francisco in which there are sixty attorneys. The Mayo Clinic has a very large staff of medical men and is known throughout the country.

A number of Mr. Baker's statements are not very accurate. He says that the professional man may not advertise. Professional men do advertise by appearing before groups, by publishing papers and in many other ways. The prime purpose may not be advertising, but there is no objection to this form of advertising. He says, "Seldom was any member of such an organization called upon to render a personal opinion based on his own individual judgment, experience or effort." I have sat in on many conferences in which the members of the organization expressed their personal opinions. Furthermore, the head of the organization usually assumed responsibility for the final decision after considering the diverse opinions of the members of the group.

I see no conflict in the idea that a professional man is also a business man. Unless he is wealthy, he must sell his professional services or starve. If those services are essentially professional they remain so whether they are sold man to man, through an organization, or as a public servant.

George L. Sullivan, M. ASCE
Consulting Engineer

Santa Clara, Calif.

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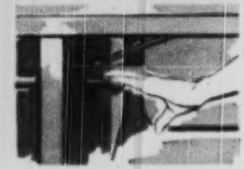

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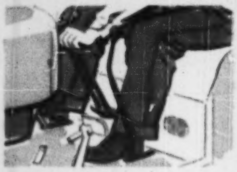

Instant speed change up or down one speed, or stop, without declutching. Planet Power drive does it!

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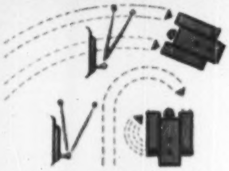

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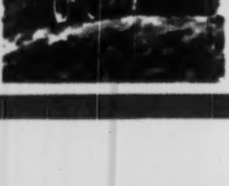

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Recent BOOKS

A.S.T.M. Specifications for Steel Piping Materials, prepared by ASTM Committee A-1 on Steel, December, 1949. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 328 pp., illus., diagrs., charts, tables, 9×6 in., paper, \$3. The standards included in this volume cover pipe used to convey liquids, vapors and gases at normal and elevated temperatures; still tubes for refinery service, heat exchanger and condenser tubes, and boiler and superheater tubes. Specifications for such allied materials as castings, forgings, bolts and nuts are also included.

Author's Guide for Preparing Manuscript and Handling Proof. John Wiley & Sons, New York; Chapman & Hall, London, 1950. 60 pp., diagrs., charts, $9\frac{1}{4}\times6$ in., linen, \$2. This book instructs the author in the efficient preparation of manuscript and illustrations, and explains the publishing procedure from the time the manuscript is submitted until the book is printed. The best and most economical methods of handling proof are described, and there is a glossary of terms.

Basic Engineering Drawing. By W. W. Turner, C. P. Buck and H. P. Ackert. Ronald Press Co., New York, 1950. 660 pp., illus., diagrs., charts, tables, $9\frac{1}{4}\times6$ in., cloth, \$4.50. Based on results obtained through classroom experience, this book integrates the material from college level courses in engineering drawing, descriptive geometry, and machine drawing. The theory and practice of drawing here presented is in keeping with the latest recommendations of the American Standards Association and with current industrial practice. Numerous problems covering a wide range of subjects and of varying degrees of difficulty are included as well as a glossary of shop terms, equipment and procedures.

Bergschadenkunde. By C. Niemczyk. Verlag Glückauf, Essen, Germany, 1949. 291 pp., illus., diagrs., charts, maps, tables, $11\frac{1}{4}\times8\frac{1}{4}$ in., cloth, 36 *DM*. This book discusses the damages arising from earth and rock movements due to mining operations or natural causes. Part A deals with surface damage caused by subsidence, and includes the problem of safety for roads, pipes, car tracks, railroads, furnace installations, and other structures. Part B covers mine damage underground in detail, reviews the various theories concerning soil pressure effects and the mechanical properties of rocks, and discusses measuring techniques with which the imminence of damaging pressures may be detected.

Composition for Technical Students. By J. D. Thomas. Charles Scribner's Sons, New York, Chicago, Atlanta, San Francisco, 1949. 460 pp., illus., diagrs., charts, tables, $8\frac{1}{2}\times5\frac{1}{2}$ in., cloth, \$3.75. Beginning with a brief discussion on style, this text reviews fundamentals (grammar, diction, punctuation, etc.), covers the main topics of technical composition, and considers the following topics in detail: Letter writing, library research, technical reports, and technical speeches. Selected examples of effective engineering writing are appended. The book is designed as a college text, but should be of general use as well.

Conservation of Oil and Gas, a Legal History, 1948. Edited by B. M. Murphy. American Bar Association, Section of Mineral Law, Chicago, Ill., 1949. 754 pp., tables, $9\frac{1}{2}\times6\frac{1}{4}$ in., cloth, \$3. This book presents a record of the efforts of oil and gas producing states and of the federal government toward conservation of these natural resources. The first section covers briefly the fundamentals of reservoir behavior that relate to the conservation of oil and gas; the second gives the legislative, administrative, and judicial concepts as applied within the jurisdictions of the states; the third deals with the interstate compact; and the fourth and last with the efforts of the national government. The book is well documented.

Engineering Structures, Colston Papers based on a symposium promoted by the Colston Research Society and the University of Bristol in September 1949. Academic Press, New York; Butterworths Scientific Publications, London, 1949. 260 pp., illus., diagrs., charts, tables, $10\times7\frac{1}{2}$ in., cloth, \$4. A special supplement to the British magazine "Research," this symposium contains fifteen articles on topics drawn from a wide range of structural applications: carrying capacity of beams; buckling; plasticity; deformation of structural elements under load; riveted joints; and etc. Attention was concentrated on problems associated with non-linearity in structural behavior. Reference lists accompany most of the articles.

Engineering Surveys: Elementary and Applied. 2 ed. By H. Rubey, G. E. Lommel and M. W. Todd. Macmillan Co., New York, 1950. 722 pp., plus 169 pp., diagrs., charts, tables, 8×5 in., cloth, \$5. This combined volume serves as a text and reference book for both elementary and advanced courses. It covers instruments and methods of measurement, the making of field notes, computations, and the organization of surveys. The more advanced material deals with horizontal and vertical control methods, engineering astronomy, topographic details, and procedures for a wide range of survey operations. Legal principles are briefly considered, and the necessary tables of technical data are included.

Fire in Buildings. By E. L. Bird and S. J. Docking. D. Van Nostrand Co., New York, London, Toronto, 1947. 295 pp., illus., diagrs., charts, tables, $8\frac{1}{4}\times5\frac{1}{2}$ in., fabrikoid, \$4.50. Addressed primarily to architects and town planners, this book states the principles of fire protection and explains the reasoning which underlies safety codes and fire regulations. Following an historical outline, the principles of fire growth and protection, causes of fire, means of escape, behavior of materials in fire, fire grading of buildings, and special types of buildings are discussed. Actual cases are used for examples. A bibliography is included.

Handbook of Aerial Mapping and Photogrammetry. By L. G. Trorey. Cambridge University Press, American Branch, 51 Madison Ave., New York; also Cambridge, England, 1950. 178 pp., illus., diagrs., charts, maps, tables, $10\times6\frac{1}{4}$ in., cloth, \$5. Intended for the drawing office, this manual describes a variety of techniques for making maps from air photographs. The methods described are mainly the newer ones developed during and since the war. Procedures, calculations, and instruments are covered in logical order in a step-by-step manner. In an appendix, the standard mapping procedure of the Royal Canadian Engineers is given in detail.

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

Highway Design and Construction. 3 ed. By A. G. Bruce and J. Clarkeson. International Textbook Co., Scranton, Pa., 1950. 734 pp., illus., diagrs., charts, maps, tables, $9\frac{1}{4}\times6$ in., cloth, \$7.25. A comprehensive and thorough treatment of fundamentals which covers modern methods for road surfaces of various types. In addition, special stress is placed on such topics as preliminary studies, including planning surveys; highway classification; vehicle characteristics; driver behavior; sight distance; preliminary location studies; origin and destination studies; traffic studies; intersection study and treatment; highway capacities; and speed characteristics.

Highways in our National Life, a Symposium, edited by J. Labatut and W. J. Lane. Princeton University Press, Princeton, N. J., 1950. 506 pp., illus., diagrs., charts, maps, tables, $9\frac{1}{2}\times6\frac{1}{4}$ in., linen, \$7.50. This symposium is composed of 45 essays by specialists in various aspects of highways. The first nine essays are historical in nature. The remaining essays, covering analytical aspects, deal with the functions and forms of the highway today. They may be divided into five general groups—social aspects, economic problems, legal aspects, physical (technique and art of the highway) problems, and highway operation. In conclusion, a summation of the symposium is included, which gives a synthesis of the problems of the highway as they relate to the concept of the future planning of the highway structure in the United States.

Manual of Highway Construction Practices and Methods. American Association of State Highway Officials, 1220 National Press Building, Washington 4, D.C., 1949. 181 pp., tables, 9×6 in., paper, \$2.50. Acceptable practices and methods currently used in various types of highway construction work in the United States are described in detail. The nature of the work to be performed, the materials to be used, the objectives to be attained, and the principles involved are also discussed. Soils, drainage, earthwork, various kinds of base and surface courses, and portland cement concrete are the major topics covered.

Photoelasticity, Principles and Methods. By H. T. Jessop and F. C. Harris. Dover Publications, New York, 1950. 184 pp., illus., diagrs., charts, tables, $9\frac{1}{2}\times6\frac{1}{4}$ in., linen, \$3.50. Written for those who wish to undertake practical work on stress-exploration, this book emphasizes principles and their application in the derivation of the standard equations and in the devising of appropriate methods of procedure. It is not intended to be a treatise on the theory of photoelasticity. Stresses, strain and stress-strain relations, optics, polarization and double refraction, reduction and interpretation of observations, stresses in three dimensions, equipment, materials, and procedures are the topics covered.

Principles and Practice of Flow Meter Engineering. 7 ed. By L. K. Spink. Foxboro Co., Foxboro, Mass., 1949. 418 pp., illus., diagrs., charts, tables, $8\times5\frac{1}{4}$ in., cloth, \$7. This book serves both as a source of important flow data and a guide to correct methods of measuring flow. Part I covers all phases involved in the measurement of any liquid with an orifice, flow nozzle, Venturi tube, or other devices. In Part II, calculations in weight units of compressible fluids are considered. Part III contains the calculation procedure developed especially for the measurement of fuel gases but is adaptable for any gas which reasonably conforms to the perfect gas laws.

Principles of Sedimentation. 2 ed. By W. H. Twenhofel. McGraw-Hill Book Co., New York, Toronto, London, 1950. 673 pp., illus., diagrs., charts, maps, tables, $9\frac{1}{4}\times6$ in., cloth, \$6.50. Retaining the same approach, organization, and comprehensive treatment of the previous edition, this book presents in addition the progress that has been made in the study of marine sediments and sedimentary processes in the sea. A discussion of the origin of sediments in general and the origins of different forms of sediments in particular is included, which covers the source, transportation, deposition, and formation of sedimentary rocks.

Road Traffic and Its Control. (Roadmakers' Library, Vol. VII.) 2 ed. By Sir A. Tripp. Longmans, Green & Co., New York; Edward Arnold & Co., London, 1950. 416 pp., diagrs., charts, maps, tables, $9\frac{1}{4}\times6$ in., linen, \$7.50; 40s. This book considers the problem of motor vehicle traffic and offers solutions in the form of designs for new roads and the improvement of existing ones. Traffic control by law and police, traffic policy, construction and mechanical appliances, road government and administration, road transport, statistics, and road casualties are the major topics covered.

Sewerage and Sewage Treatment. 3 ed. By W. A. Hardenbergh. International Textbook Co., Scranton, Pa., 1950. 467 pp., illus., diagrs., charts, tables, $9\frac{1}{4}\times6\frac{1}{4}$ in., linen, \$6.50. Written from the viewpoint of the practicing engineer, this book considers the treatment of sewage and industrial wastes to meet present-day standards of stream sanitation. The design and operation of sewer systems and treatment plants are covered in detail, and the waste products of various industries are discussed. Major revisions in this edition have been made in the material on industrial wastes, trickling filters, and the activated sludge process.

(Continued on page 78)

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Rental Charge Expedites Sewage Treatment Program

(Continued from page 44)

ft in diameter. Most of this latter work will be built as a rock tunnel.

The total cost of the present sewage disposal program is \$60,000,000, based on 1949 costs. This is in addition to work costing about \$25,000,000 which was carried out in the 25-year period preceding 1940. The schedule calls for the entire \$60,000,000 program to be placed under contract in the six-year period from 1947 to 1952 inclusive, with the entire system completed and in operation by the end of 1953. The Northeast Works is planned to start operation in the fall of 1950, and the other two plants are scheduled for completion in 1953.

To date, contracts totaling $25,400,000 have been awarded. Work with an estimated cost of $12,000,000 is scheduled to be placed under contract before the end of 1950.

All plans and specifications are prepared by the Bureau of Engineering, Surveys and Zoning of the Department of Public Works, and construction is under the supervision of the Bureau. Thomas Buckley, M. ASCE, is Director of Public Works, and A. Zane Hoffman is Chief Engineer and Surveyor. The writer, as Assistant Chief Engineer, has direct responsibility for design, construction, and operation of sewage treatment facilities. E. R. Schofield, M. ASCE, until September 1949, and John R. Grandinetti, have been Principal Assistant Engineers in charge of design. Max Barofsky, M. ASCE, is Principal Assistant Engineer in charge of construction. Samuel Greeley, M. ASCE, of Chicago, acted as special consultant on some phases of the design.

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Successful Engineers Never Stop Learning

(*Continued from page 39*)

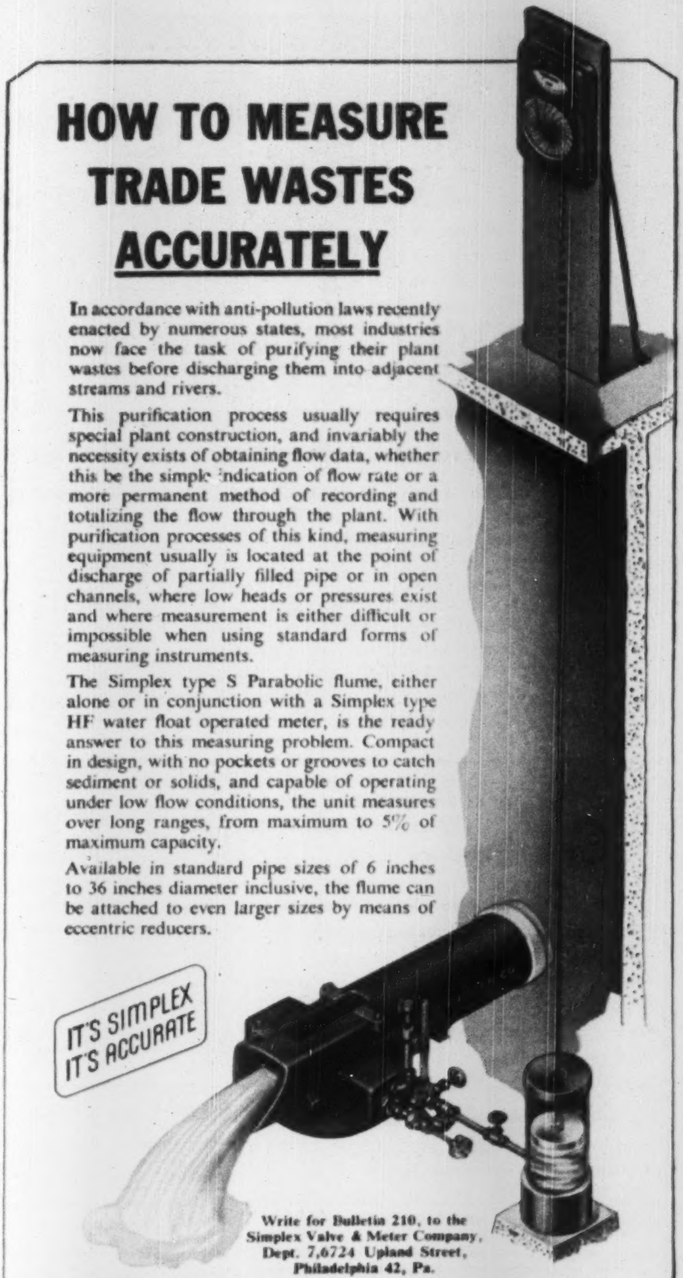
should continue to study and learn while he waits for his opportunity to come.

Constant Vigilance Is the Price

To achieve these attitudes requires constant vigilance. The college, industry, and the professional societies must help the young engineer establish a consistent set of values. If the young engineer wants to be professionally competent, he can be so, but the price is a willingness to learn—to work hard and unceasingly—in other words his professional development is a continuing process.

We have a great responsibility toward our young engineers, and it is one of our privileges to be able to serve our profession by serving them. Let us do everything in our power to help them maintain their faith in themselves, their faith in their fellow men, their faith in their profession, and their faith in God. Only thus can they achieve the goal we hope to see them reach, and only thus can humanity benefit and the cause of freedom be advanced.

(This article is based on the author's address at a recent joint meeting of the ASCE Pittsburgh Section and the Engineers' Society of Western Pennsylvania at Carnegie Institute of Technology.)



HOW TO MEASURE TRADE WASTES ACCURATELY

In accordance with anti-pollution laws recently enacted by numerous states, most industries now face the task of purifying their plant wastes before discharging them into adjacent streams and rivers.

This purification process usually requires special plant construction, and invariably the necessity exists of obtaining flow data, whether this be the simple indication of flow rate or a more permanent method of recording and totalizing the flow through the plant. With purification processes of this kind, measuring equipment usually is located at the point of discharge of partially filled pipe or in open channels, where low heads or pressures exist and where measurement is either difficult or impossible when using standard forms of measuring instruments.

The Simplex type S Parabolic flume, either alone or in conjunction with a Simplex type HF water float operated meter, is the ready answer to this measuring problem. Compact in design, with no pockets or grooves to catch sediment or solids, and capable of operating under low flow conditions, the unit measures over long ranges, from maximum to 5% of maximum capacity.

Available in standard pipe sizes of 6 inches to 36 inches diameter inclusive, the flume can be attached to even larger sizes by means of eccentric reducers.

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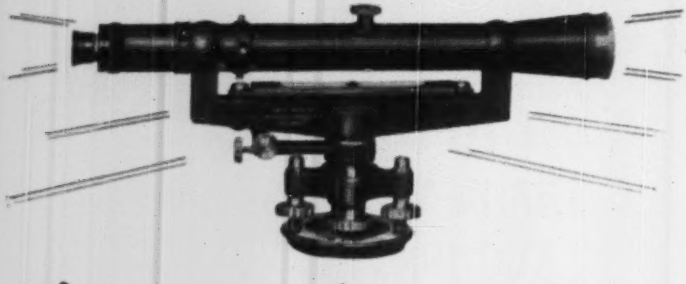

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Features	D. White No. 7080	Instrument A	Instrument B
Magnifying Power of Telescope	35X	30X	27X
Distance away you can read 1/100 ft. graduation	1200 ft.	1050 ft.	900 ft.
Diameter of objective lens	1.81 in.	1.485 in.	1.69 in.
Field of view (In minutes of arc)	64'	52'	60'
Coated optics	YES	YES	YES
Covered Leveling Screws	YES	YES	YE
Can you easily replace worn leveling screws in the field?	YES	NO	YES
Sensitivity of level vial (in seconds of arc per 2mm of graduation)	20"	20"	25"
Price — Complete with carrying case, tripod and accessories — F.O.B. factory	$245.00	higher	higher

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(Continued from page 76)

SALES ENGINEERING. 2 ed. By B. Lester. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950. 226 pp., diagrs., 8½×5½ in., linen, $3. Sales engineering is defined as the art of selling equipment and services which require engineering skill in their selection, application, and use. The author discusses the field of sales engineering, describes the work of the sales engineer under current conditions, and indicates the training and development of the sales engineer.

STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING, 2 Vols. Adopted and published by the American Association of State Highway Officials, 1220 National Press Building, Washington, D.C. 6th ed., 1950. Part I, 231 pp.; Part II, 414 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $6. per set, not sold separately. Part I contains 94 specifications broadly classified under the following headings: Hydraulic cement; bituminous materials; soils; aggregates; brick; expansion joint fillers and asphalt plank; culvert and sewer pipe; bridge paints; reinforcing steel and wire rope; metallic materials for bridges; and miscellaneous. Part II contains 120 test methods under the same headings except that the paint, sewer pipe, and reinforcing steel classifications are not represented, and a group under concrete has been added. In each volume numerous deletions, combinations, revisions, and additions have been made in line with current practice.

TESTING OF BITUMINOUS MIXTURES, a Laboratory Handbook concerning Road and Building Materials. (Roadmakers' Library.) 2 ed. By D. C. Broome. Longmans, Green & Co., New York; Edward Arnold & Co., London, 1949. 396 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $8. Designed as a laboratory manual, this book describes standard methods and equipment for those who test bituminous road and building materials and their constituents. In this second edition new methods have been added, including, in particular, descriptions of tests more applicable to tar and tar mixtures. Several hundred literature references are given to which reference is made throughout the text.

THEORETICAL HYDRODYNAMICS. 2 ed. By L. M. Milne-Thomson. Macmillan Co., New York, 1950. 600 pp., diagrs., charts, tables, 9½×6¼ in., cloth, $8.50 (60s, London). Based on lectures to junior members of the Royal Corps of Naval Constructors, this book provides a clear and methodical introductory exposition of the mathematical theory of fluid motion, which will be useful in applications to both hydrodynamics and aerodynamics. Vector methods and notation and the complex variable are used. A knowledge of the elements of the infinitesimal calculus is assumed. Three important changes in this second edition are the introduction of the circle theorem, the theorem for the sphere, and the addition of a chapter on the flow of compressible fluids.

THE RIGID FRAME BRIDGE. 3 ed rev. By Arthur G. Hayden and Maurice Barron. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1950. 240 pp., illus., diagrs., tables, drawings, 9¼×6 in., cloth, $5. This book presents a greatly simplified method of analysis for skewed frame bridges that cuts down design time, design cost, and reduces the chance of error.

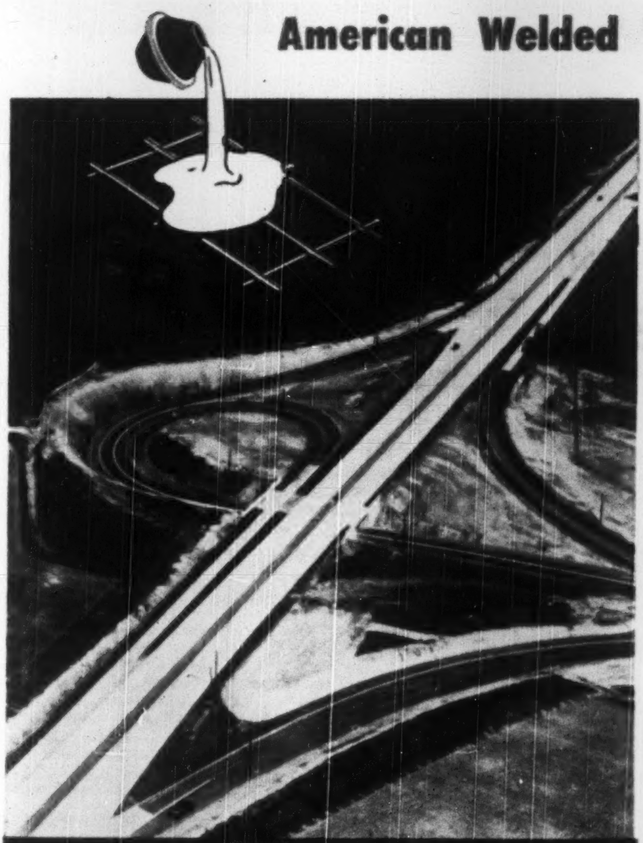
THE SLIDE RULE. By Lee H. Johnson. D. Van Nostrand Co., Inc., New York, Toronto, London, 1949. 242 pp., illus., 9¼×6 in., cloth, $3. The modern duplex slide, as a versatile and efficient tool of calculation, is fully described. The techniques presented are based on a new concept of slide rule operation.

UNIVERSITIES OF THE WORLD OUTSIDE U.S.A. Edited by M. M. Chambers. American Council on Education, Washington, D.C., 1950. 924 pp., 9¼×6½ in., cloth, $12. More than 2,000 institutions of higher education in some eighty countries and localities outside of the U.S.A. are covered in this volume. A general survey of the educational conditions in each country is included, as well as a discussion of the international exchange of students and teachers.

WINDS, WAVES AND MARITIME STRUCTURES, Studies in Harbour Making and in the Protection of Coasts. By R. R. Minikin. Charles Griffin & Co., Ltd., London, W. C. 2, 1950. 216 pp., illus., diagrs., charts, tables, 9×6¼ in., fabrikoid, 25s. Written from the engineering viewpoint, this book defines and classifies sea processes and their effects, and deals in a practical manner with problems concerning maritime structures. It treats in detail wave action, breakwaters, and jetties, and includes chapters on sea walls, slipways, and dredging. Using a mathematical treatment, the author shows how problems are best solved in modern engineering practice.

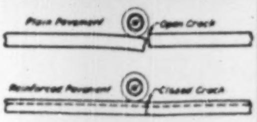
On the Pennsylvania Turnpike

American Welded Wire Fabric



Longer paving slabs, fewer joints, improve riding qualities on concrete highways reinforced with American Welded Wire Fabric. Reduced rate of cracking, prevention of heaving and spalling, also reduce maintenance costs, increase service life of the highway.

As the wheel load approaches an open crack in plain pavement, one slab end carries the entire load. As the wheel load approaches the closed crack in pavement reinforced with American Welded Wire Fabric, both slab ends, instead of one, carry the load, preventing damage to the slab and to the subgrade.



THE men who plan and build our modern concrete superhighways have helped to make American Welded Wire Fabric the world's most widely used reinforcement for pavement construction.

American Welded Wire Fabric keeps cracks that may form tightly closed—preventing progressive damage — distributes stresses, strains and impact in all directions.

U·S·S American Welded Wire Fabric reinforcement in rolls or in flat sheets is easily handled, lies flat and stays in place. This means important savings in labor costs and construction time.

Standard styles of U·S·S American Welded Wire Fabric are available in every locality from jobbers' stocks when furnished in rolls. When flat sheets or special styles of fabric are required—you can depend upon our Donora, Pa. and Joliet, Ill., mills to maintain your construction schedules.

When you are planning any type of concrete construction, our technical staff will supply complete data on specific designs and standard styles of fabric that are most readily available. Literature containing valuable information is also available. Write to our nearest sales office today, you incur no obligation.

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EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Rough Terrain Compressor

A SPECIAL 500-FT pipeline model Blue Brute portable air compressor is now available. With a standard engine and compressor unit mounted on pneumatic tires, it is designed to operate in rough terrain and on unusually steep inclines. It is built to give continuous performance under the unfavorable dusty conditions encountered in pipeline construction. The unit is equipped with a special oil bath air cleaner, a steep angle oil sump, and a readily accessible heavy-duty replaceable cartridge oil filter. Additional information can be obtained by writing **Worthington Pump & Machinery Corp., Construction Equipment Div., Holyoke, Mass.**

◆

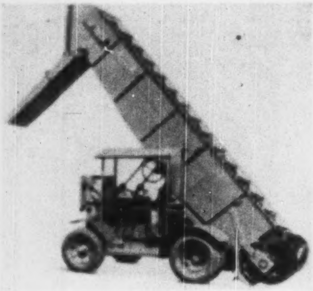
Motor Grader

THE MODEL 900 IS THE newest addition to the famous American motor grader line. It is an inexpensive machine—yet it has more than enough power and speed to perform every maintenance job. The 12,000-lb Model 900 is powered by a 50-hp Minneapolis-Moline gasoline engine. A large 12-ft blade designed for greater angularity and pitch makes it possible to cut 3-ft ditches with proper "slicing" (not bulldozing) action. Long 16-ft 4-in. wheelbase, plus large hydraulically controlled circle, gives rigid support and holds blade to a smooth, steady cut that eliminates "wash-boarding." The American 900 is completely hydraulic. Every operation can be instantly and accurately controlled by self-centering control levers in cab. The following optional equipment may be installed to make the 900 the most versatile motor grader available today—9-tooth, replaceable tip scarifier, low-lift material handling buckets, $^1/_2$ or 1 cu yd capacity, bulldozer, vertical moldboard, width 78 in., height 30 in., V-type snow plow, 9-ft, 6-in. swath; reversible snow plow, 10-ft cutting edge. Hi-Lift loader, $^1/_2$-cu yd bucket, 48-in. cutting edge and 1-cu-yd snow bucket with 78-in. cutting edge. The No. 900 was designed for township, municipal, and county road construction and maintenance. It also meets the maintenance requirements of State Highway Departments. **American Road Equipment Co., Omaha, Nebr.**

Model 900

Bucket Loaders

TWO HEAVY-DUTY BUCKET LOADERS are now in production. Model P-11 is mounted on wheels and Model Q-11 on crawlers. Both machines handle any loose material up to 3-in. cube, either from stock piles or bank run sand and gravel pits. Rated loading capacity is 3 to 4 cu yd per min, max wt of 150 lbs per cu ft. Many of the features pioneered by Nelson—such as hydraulic boom control, Timken bearing elevator, 3-point mounted spiral feed shaft—are supplemented in the "11" series machines by wear-resistant manganese steel bucket chains, sprockets, bucket edges, and spiral feeder edges; more powerful engine and larger Twin-Disc clutches with double roller chain transmission drive. The hoist has dual double-acting cylinders. Tested and proved in more than 500 Nelson loaders is the compact, precision-built 2-in-1 transmission and differential, encased in a single oil-filled housing. Both models are identical in construction and operation except for mounting and incidental details. **N. P. Nelson Iron Works, Inc., Clifton, N. J.**



Model P-11

◆

Root Ripper

THE ROOT RIPPER, a companion tool to the Baker line of bulldozers and gradebuilders, is announced. The root ripper, designed for general land-clearing operations, may be purchased as an interchangeable attachment for cable and hydraulic bulldozers and gradebuilders, or as a complete machine. The new tool is recommended for removing and piling brush, roots, rocks, or boulders. The attachment consists of nine teeth, securely bolted to horizontal cross members, which are rigidly tied together by brackets for quick attachment to the bulldozer or gradebuilder frame. Teeth are one-piece steel castings, correctly curved to produce a rolling action to material handled so that dirt is shaken loose and filtered between the teeth. Write for Bulletin 887. **Baker Mfg. Co., Springfield, Ill.**

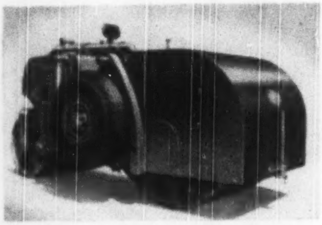
Plastic Pipe

THE AVAILABILITY OF flexible and rigid types of Carlon plastic pipe for a wide range of applications in the construction industry has been announced. The pipe is tough, durable, resilient, extremely light in weight, and guaranteed against rot, rust, and electrolytic corrosion. Carlon pipe can be used for drinking water, drainage and irrigation systems, ventilating and cooling lines, hydraulic sluicing, and intake and exhaust piping. In addition, Carlon has application in transmitting sludge, as low-pressure air lines, and, in some installations, as both exposed and concrete incased electrical wiring conduit. A few of the outstanding features are as follows: weighs only $^1/_7$ as much as steel and lasts longer, curves to follow surface contours and eliminates many fittings, connections are quickly made with standard type fittings and the pipe's light weight cuts handling and installation costs. **Carter Products Corp., 10241 Meech Ave., Cleveland 5, Ohio.**

◆

Retractable Wheel Roller

THE RETRACTABLE WHEEL ROLLER, a portable, completely self-contained unit for a broad range of applications in the road building and maintenance field has been announced. A full 5-ton tandem roller, the machine travels easily and quickly from one job to another. It can be towed behind either a truck or Huber's Road Maintainer at normal highway speeds. The roller uses its own power to raise and lower the trailing mechanism that is built integral with the frame. While the roller is being towed, the rolls ride 9 in. from the ground. It is powered by a 4-cylinder, V-type, air-cooled gasoline engine. Final drive is through a heavy-duty roller chain running on heat-treated sprockets. Hydraulic power for lifting or lowering the trailing wheels is supplied by a gear pump driven by an adjustable-tension V-belt from the engine crankshaft. Write for Bulletin No. T-143. **Huber Mfg. Co., Marion, Ohio.**

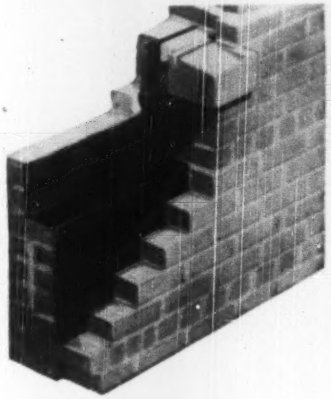


Completely Self-Contained Unit

Equipment, Materials & Methods (Continued)

Preformed Waterproofing Units

THE PURPOSE OF THE Larson system of waterproofing, which has been tested under varying conditions and in many buildings, is to stop leaks in masonry walls above grade by providing an impenetrable membrane barrier within the wall. Preformed waterproofing units are designed to be laid in brickwork as it is built. The membrane consists of 35-lb



mineral base felt saturated and coated with a high-grade asphalt. The units fit around windows and over spandrels and in the vertical joints behind the face brick and under the headers at every sixth course. This arrangement of waterproof felt in the wall precludes water penetration beyond the exterior facing brick. The units thus form a complete built-up membrane within the walls, covering the entire area from the top of the foundation walls to roof or underside of copings. The units are sealed to all windows, doors, or any other openings in the wall. They are carried in front of all beams, columns, pipe chases, and recesses and are fitted around all corners. Face brick is bonded to back-up construction without interfering with continuity of the membrane. All joints in the membrane are lapped at least 4 in. and sealed with a reliable mastic compound. Columbia University tests indicate that the introduction of the units does not weaken the wall. The New York City Board of Standards and Appeals, after thorough examination by its engineers, approved the system. **Brisk Waterproofing Co., 103 Park Ave., New York 17, N.Y.**

◆

Electric Vibrator

AN ELECTRIC VIBRATOR, recently introduced, is designed to do concrete placing jobs quicker, better, more economically, to eliminate hand puddling, place stiffer mixes more rapidly, increase the density and watertightness of the concrete, for

(Continued on page 84)

Ever been haunted by an "ERASURE GHOST"?

The beauty of Arkwright Tracing Cloth is its *permanent* translucency — built all the way through the cloth by a special process. Arkwright will take the heaviest erasures* without "ghosting". You can count on clear, clean prints from drawings on Arkwright cloth years after you make them.

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Think a moment. Isn't it an unnecessary risk to put your important drawings on inferior tracing cloth or paper? A sample will show you the difference. Write Arkwright Finishing Company, Providence, R.I.

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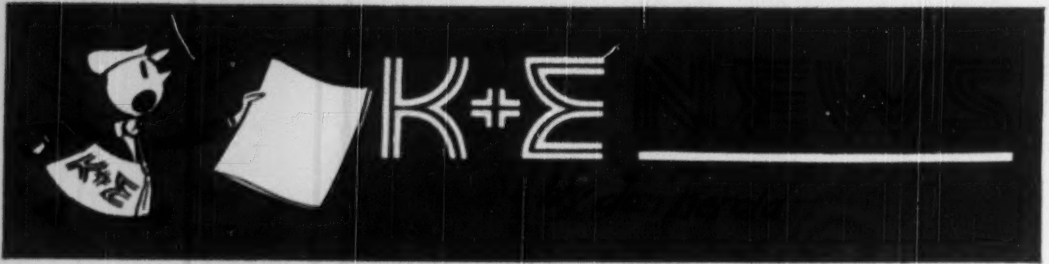

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HELIOS * dry developed, positive line prints on white backgrounds are exactly like your originals. You can count on their uniformity, crispness and clearness, whether the lines are black, blue or maroon.

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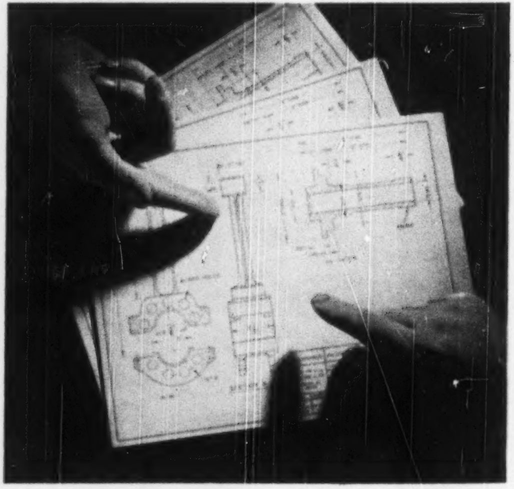
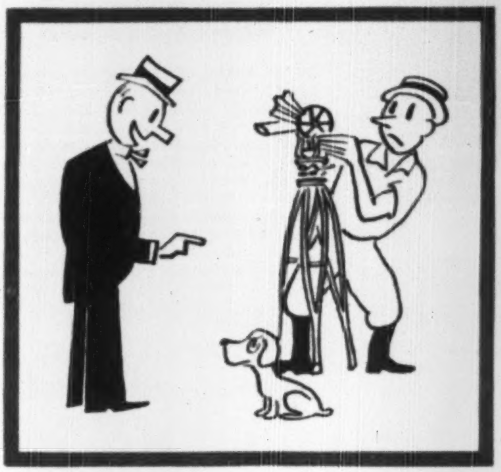
You can have HELIOS in opaque papers and opaque cloth for working prints, besides transparent papers and cloth, and clear and matte films, for intermediate originals (to use in place of originals).

You can print and develop HELIOS reproductions easily with any dry diazo ammonia process machine—even in a small office. No water, no wet mess, no plumbing—just a few seconds of a simple vapor treatment, and the job is done.

*Trade Mark ®





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has it a pedigree?"

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When you buy surveying instruments, you're not buying toothpicks or neckties. You're buying accuracy and endurance for a lifetime. And you're spending real money.

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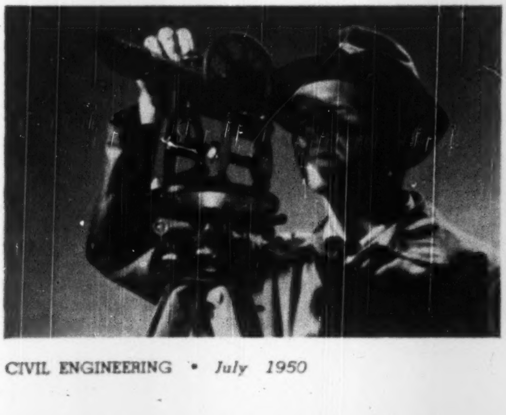
These questions are all pretty well answered in Keuffel & Esser's 83-year-old reputation for making mighty good things for engineers and draftsmen. For 83 years, K&E equipment and materials have been partners in nearly every engineering project of any size anywhere. So, that's why I say: buy K&E PARAGON Surveying Instruments.



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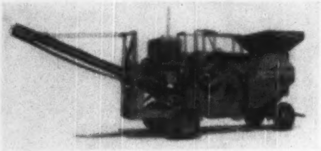
Equipment, Materials & Methods (Continued)

greater flexural and compression strength. Saves time and money too, because it permits earlier stripping and removal of forms, earlier finishing of surfaces and reduces patching costs to a minimum. Lightweight, sturdy and powerful, this new electric vibrator is equipped with trouble-free Stow flexible shaft, and Sealed-in-oil vibrator head. The motor, which delivers up to 9500 rpm, is protected by special skid-mounting and has double handles for lifting in either the horizontal or vertical position. For more detailed information, write to **Stow Mfg. Co., Binghamton, N.Y.**

◆

Crushing and Screening Plant

The new "61" portable crushing and screening plant is designed for fast, economical production of crushed rock or gravel where extreme accuracy in grading to size is not required. This compact, adaptable unit is especially suited to the maintenance needs of town and country road departments. The lightweight and readily portable "61" can be quickly moved to any location to simplify hauling problems. Simple design and sturdy construction keep operating and maintenance costs at a minimum. **Austin-Western Co., Aurora, Ill.**



The Portable "61"

◆

Locomotive Crane

The latest model locomotive crane, known as the Browning Torqflo, operates with torque converter power, which is similar in operation to the automatic transmissions in automobiles, and is available in three models, having from 25 to 50 ton capacities. The Browning Torqflo drive is a specially designed hydraulic power transmission unit which provides effortless, smooth and fast operation to the travel, swing, hoist, and boom hoist mechanisms. Shocks to cables, clutches and gear train are entirely eliminated through the automatic adjustments of the converter, which always supplies the correct amount of power required for each operation. The converter hydraulically absorbs sudden increases in loads, which means there is little wear on the clutches and brakes, and the smooth and powerful operation of the drive makes it highly suitable for car switching, magnet, hook block, bucket, or pile driver work. **The Browning Crane & Shovel Co., 16226 Waterloo Rd., N.E., Cleveland 10, Ohio.**

Equipment, Materials & Methods (Continued)

Portable Mixer

A PORTABLE MULTI-BLADE MIXER has been produced primarily for the mason contractors, plasterers, and the road-building industry. Power for the mixer is provided by either electric motor, gas, or diesel engine. Mixing time is 3 min or less for mixes of plaster, concrete, or other aggregates. The unit is complete with a discharge door located at the correct height to permit use of a standard wheelbarrow. The necessity of special platforms, rigs, etc., is thus eliminated. Replaceable liners and paddles of high-carbon steel reduce maintenance problems. Shafts operating in anti-friction bearings are equipped with alemite lubricating units. The mixer is of sturdy steel plate welded construction mounted on a welded steel truck provided with four standard pneumatic-tired automobile wheels. A tow-bar is provided on the steerable front wheels. Machine is of minimum width to permit passage through narrow doors and aisles. The Multico mixer is produced in three, five, seven, and twelve cu ft capacities. **Multiplex Machinery Corp., Elmore, Ohio.**

Available in Four Sizes

◆

Hardfacing Alloy

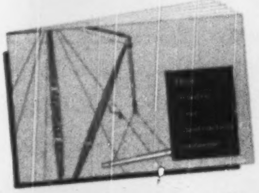
A HARDFACING ALLOY, Aircolite 50, has been added to Air Reduction's line of hardfacing alloys. The alloy, which has been on field trial for more than a year, is designed primarily for applications involving high stress abrasion with medium impact. Cast in rod form, Aircolite 50 is composed principally of chromium, molybdenum, carbon, and iron. It has a low coefficient of friction, and therefore acquires a high polish in service. The deposit maintains its high hardness at temperatures up to 800 deg F. The alloy is available in bare form for oxyacetylene application or coated for electric application. According to the manufacturer, Aircolite 50 is recommended for building up surfaces subject to high stress abrasion and metal-to-metal friction where impact is moderate and abrasion severe. It is suited to many applications in steel mills, foundries, and metalworking plants. **Air Reduction Sales Co., 60 E. 42d St., New York 17, N.Y.**

(Continued on page 88)

Your engineering plans are in competent hands

when M-C & S enters the building picture!

In working closely with consulting engineers for scores of years, Merritt-Chapman & Scott long ago learned the importance of giving full attention to every detail. M-C & S's extensive experience in the many fields of engineered construction is the best assurance that your assignment will be completed as designed, on time. All M-C & S project managers are performance-proved; facilities are unrivaled. And, as illustrated by the new brochure offered below, no project is "out-of-our-line."



New booklet presents a factual record of M-C & S's ability to solve the most challenging construction problems. Your copy will be sent immediately upon request to Dept. CI.

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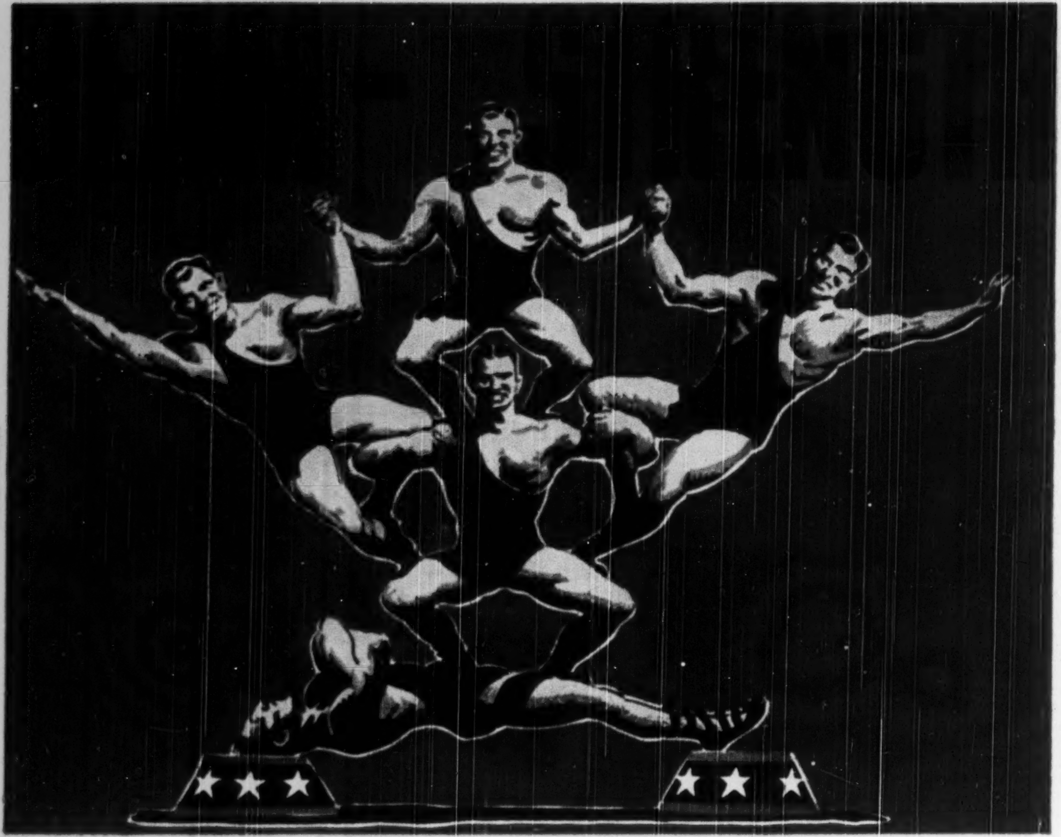


Without beam strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

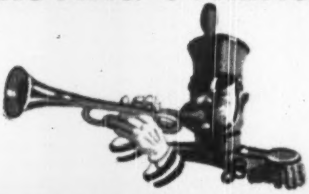
CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

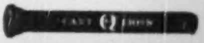
SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH



In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.



SERVES FOR CENTURIES

"GUNITE" DOMES FOR EXISTING RESERVOIRS

This photo shows one of the two "GUNITE" dome roofs built by us at Mattoon, Ill., in 1946 on tanks approximately 90' in diameter. The heavy "GUNITE" ring girders of the domes are reinforced with prestressed hoop rods. Similar domes have been constructed, by us, on existing brick reservoirs. "GUNITE" reinforcing was placed on the interior of the reservoirs and, when necessary, on the exposed surface above the ground to stop leakage and further deterioration.

We have built tanks of all "GUNITE" construction with capacities from 25,000 to 2 million gallons. Because of the imperviousness of "GUNITE" tanks, assured by our method of pre-stressing, they can be placed completely underground, on the surface or elevated with equal success. They are in use for storage of water, oil, chemicals and dry materials.

Write today, on your letterhead, for a free copy of Bulletin B2400 which is illustrated with many examples of "GUNITE" for building and repairing tanks, bridges, buildings and other structures.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

Locked in the Rock

Another tough foundation problem solved with DRILLED-IN TRADE MARK CAISSONS

Cylinders installed through 60 feet of highly plastic clay and socketed into anorthosite rock

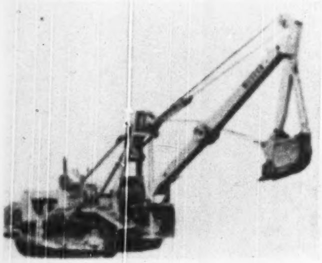
Puyjolon River crossing abutment supporting plate girder railroad bridge. Cylinders were battered 1:6 both longitudinally and transversally with bridge.

DRILLED-IN CAISSON CORPORATION
2 PARK AVENUE, NEW YORK 16, N. Y.
• SPENCER, WHITE & PRENTIS, NEW YORK
• WESTERN FOUNDATION CO., NEW YORK

Equipment, Materials & Methods (Continued)

Hoe Front

THE HYSTER D6 HYSTAWAY, tractor-mounted $^{1}/_{2}$-yd excavator may now be equipped with the hoe front which was previously available only for D7 and D8 Hystaways. Other variations already manufactured for the D6 Hystaway include interchangeable crane, dragline, and clamshell fronts, all of which are designed for easy mounting right on the job. The hoe front can be installed on either new or used Hystaways. Complete tractor mobility and maneuverability are fully retained with the attachment in place.



Model D-6

Utility use of a dozer blade on the front of the tractor is still possible, and it takes less than 1 hr to dismount the Hystaway unit to permit full production bulldozer use. The machine is currently employed by construction contractors for such jobs as pipeline trenching, excavation for bridge approaches, gravel pit operations, digging of foundation holes for power transmission towers, and other excavating projects requiring equipment to operate over rough, steep, or otherwise difficult terrain. The hoe is claimed to be able to reach farther into the excavation than other conventional machines of the same size because the center of its swing is beyond the crawlers. Standard width of the hoe dipper is 33 in., but for narrow ditching requirements, a 23-in. dipper is also available. The Hystaway is distributed through Caterpillar Tractor Co. dealers located in principal cities throughout the world. **Hyster Co., 2902 N.E. Clackamas St., Portland 8, Ore.**

◆

Rubber Compound for Surfacing

A NEW SURFACING MATERIAL that promises to protect airfield runways from the damaging effects of fuel spilled by jet planes was revealed several months ago at Wright-Patterson Field. Called Aero-Sealz, it is a solvent resistant rubber compound which, when mixed with tar, produces a tough, durable surface that resists the dissolving effects of kerosene type fuel used by jet planes. Damage caused by this fuel is a major problem in modern airport construction and maintenance due

(*Continued on page 89*)

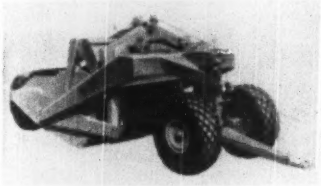
Equipment, Materials & Methods (Continued)

to its lower rate of evaporation compared with high octane gas used by regular planes. Due to the dissolving effect of the fuel the bituminous pavement is eventually stripped from the upper layer leaving loose or free aggregates. An additional hazard is the loose aggregates which are exposed to the terrific rear-end blasts of jet planes. These hard fragments may be blown in the direction of the air intake in front of another jet plane or toward the revolving propellers of another plane moving or parked nearby. Besides protecting pavement surfaces, Aero-Sealz shows promise used as a filler to seal joints between concrete slabs in highways and runways. **United States Rubber Co., Rockefeller Center, New York 20, N.Y.**

◆

Scraper

With capacities of 17 cu yds struck and 20 cu yds heaped, the new Wooldridge Model TC-170 tractor-drawn scraper has been designed for greater productivity in the large scraper field. New curved ejector and 65-in. apron opening have been engineered for faster discharge of all types of loads. Formed steel construction gives greater structural strength and trim appearance. Three-piece cutting edge together with the original Wooldridge principles of rear-draft fulcrum leverage and boiling bowl loading are said to greatly increase loading speed. Increased ground clearance gives greater maneuverability, and reengineered cable arrangement adds to stability, ease of control, and cable life. **Mr. Larry Crane, Wooldridge Mfg. Co., Sunnyvalle, Calif.**



Model TC-170

◆

Steel Clamps

Adjustable steel clamps for setting up wood forms for curb, curb and gutter and battered curb are now also adapted to setting up wood forms for building foundations. Comprised of stake and cross piece, this Pacific bolt clamp is completely adjustable to any curb and gutter cross section in general use throughout the country and thus can be set for widths from 4 to 8 in., for heights up to 24 in., and for batter from vertical to any angle. Standard steel stakes are used, which prevent kicking out of the forms at the bottom. No special or patented spreaders or

(Continued on page 90)

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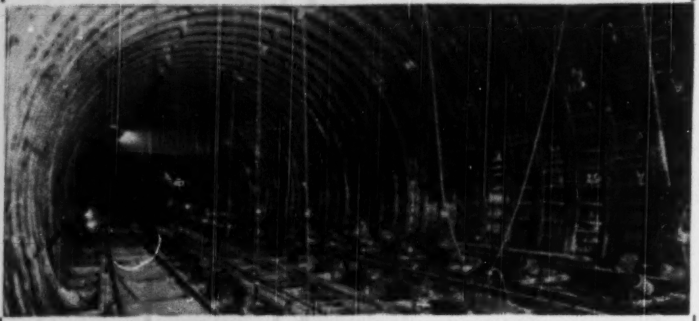

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Equipment, Materials & Methods (Continued)

wall ties are required. The forms are held rigidly in place without the need of additional bracing except in extremely soft ground conditions. According to the manufacturer, a few nails are required and the salvage of lumber is large. No tools are required to adjust the clamps because a locking lever is a part of each clamp; this locking lever holds the form true to line, grade, and shape. The face form is supported without stakes and can be removed without jarring or disturbing the fresh concrete. A new adjustable crossbar can be used with the regular stakes to set up any building foundation up to 36 in. in height and to 10 in. in width. **Pacific Engineering Sales Co., 215 West 5th St., Los Angeles 13, Calif.**

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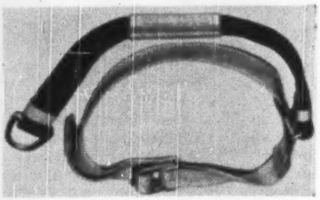
With the Safe-Hi shock absorber belt, construction bridge, maintenance and other workers are assured a new degree of safety in high work. In addition to being built to rigid safety engineering standards in all details, this belt has a revolutionary new feature: a shock absorber extention of Unolyn. Unolyn is a member of the nylon family. It has the unique ability to elongate, without rebound, to several times its original length. This action "puts on the brakes" instead of stopping a falling man with a violent jerk. The Safe-Hi belt permits the use of steel cable lifelines, safely. By stretching out the slowing down process the impact is held to a minimum. However, in the Safe-Hi shock absorber belt, the draw load and the length of the Unolyn extension are scientifically determined to get full deceleration within a few feet, to minimize the hazard of the man striking a girder or any projection before he is fully stopped. For descriptive literature write **The Rose Mfg. Co., 1731 Arapahoe St., Denver 2, Colo.**



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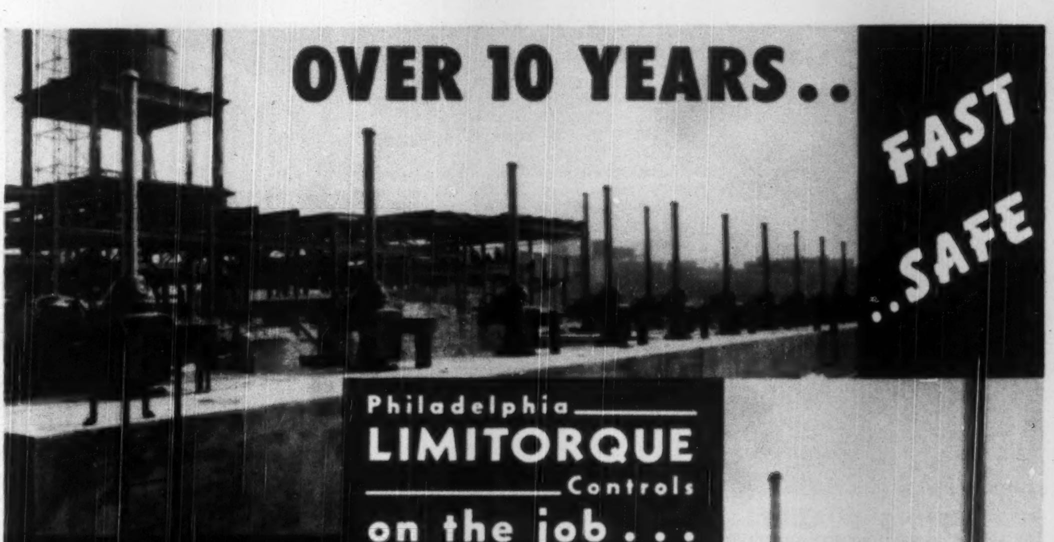
Designed for fast delivery and placement of premixed concrete, the Dumpcrete body has been improved to permit even greater production and ease of operation. The swinging baffle inside the body has been increased in over-all height and relocated to improve the discharge action of the concrete. Gate wings are built higher with longer slope than pre-

(*Continued on page 92*)



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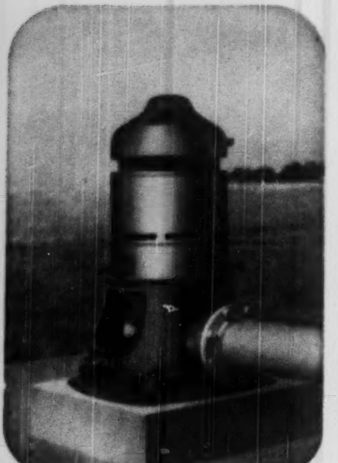

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Equipment, Materials & Methods (Continued)

viously to permit an even faster, easier unloading of the concrete. Sides of the hopper section of chute have been increased to eliminate concrete overflow and the swingaway type chute has been added to the 4-yd body, making this feature standard on all three sizes. For driver convenience, strap steps are provided on front and rear running boards, and gate discharge handles are more easily accessible. The fenders have been increased to cover dual rear tires. New type, cast-steel anchor bracket assemblies are furnished for securing the Dumpcrete to the truck chassis frame. Write for your free copy of pamphlet L-106. **Dumpcrete Div., Maxon Construction Co., Inc., 131 North Ludlow St., Dayton 2, Ohio.**

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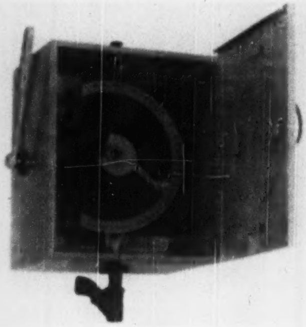

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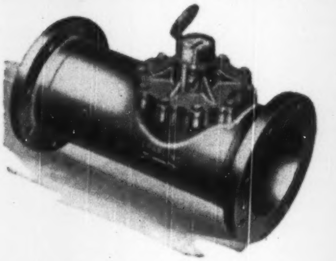

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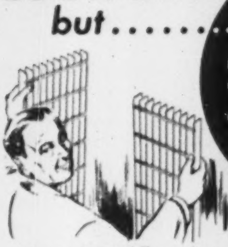

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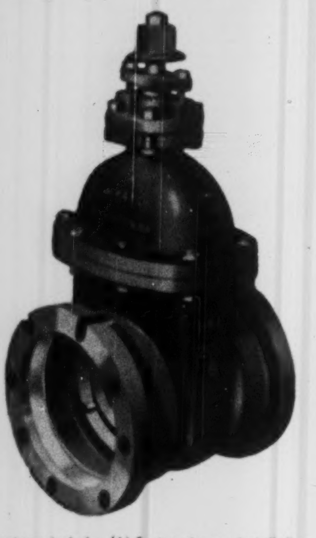

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Literature Available

Pump Drives—A bulletin on right-angle vertical pump drives is announced. These Pacific-Western pump drives are designed for transmitting high horsepower or speed. A copy of the bulletin, No. 4907, may be obtained by writing the company. **Western Gear Works, P.O. Box 192, Linwood, Calif.**

Mechanical Joints—A 4-page, 2-color pamphlet lists the high points of the Smith mechanical joint tapping sleeve. A step by step installation is described and illustrated. Technical information, sizes, and dimensions are thoroughly covered. **The A. P. Smith Mfg. Co., East Orange, N.J.**

Concrete Construction—A 12-page illustrated booklet lists detailed information and specifications on Sika compounds engineered to answer specific problems of concrete and masonry construction. Discusses 14 additional materials of construction engineered for coating, sealing, hardening, and repair work on concrete and masonry. **Sika Chemical Corp., 37 Gregory Ave., Passaic, N.J.**

Weatherproofing Product—A 4-page product data sheet describes a spray-applied plastic adhesive seal coat and colored mineral granule application for weatherproofing and restoring unsightly and leaky masonry walls. This coating system for exterior use, known as "Binderseal and Granules," consists of a spray coat of the specially compounded asphaltic material, followed by application of decorative granules which are embedded in the seal coat. **Industrial Products Div., The Flintkote Co., New York, N.Y.**

Anti-Corrosion Caustic Nickel—A technical bulletin has just been issued on the resistance of nickel and its alloys to corrosion by caustic alkalies. Twenty-four pages in size, it contains over 20 illustrations and over 40 tables. Methods of testing as well as results are given. Nickel alloy irons as well as the higher non-ferrous nickel alloys and pure nickel are discussed. Write for Technical Bulletin T-6. **International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.**

Soil Stabilizers—"World-Wide Trend to Stabilized Roads Means Many More Miles from Tight Budgets" is the title given to a 4-page 2-color folder. Many pictures of the P&H single pass soil stabilizers on jobs with job information are included. Also, it carries a large cutaway drawing, explaining operation and condensed specifications. Ask for Bulletin S-8. **Stabilizer Div., Harnischfeger Corp., 4400 West National Ave., Milwaukee 14, Wis.**

Rental Instruments—A portfolio of information describes a service recently made available to engineers and scientists. The rental instruments described in this catalog are reliable and accurate instruments by leading manufacturers. Rental information on recording ammeters, voltmeters, wattmeters and current transformers are included with three instrument rental requirement forms. **InstruRental Co., 411 Albee Bldg., Washington 5, D.C.**

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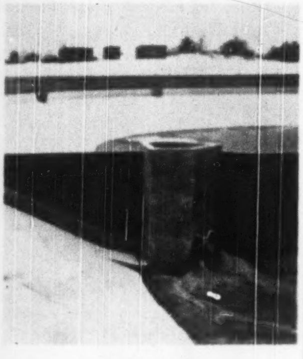

Fig. B-144-A

One of Two 48" Type M Gates installed in Ft. Stanton Park Reservoir, Washington, D. C., to maintain direction of flow. See Feb. 22, 1944, issue Engineering News Record for story about this project.

BROWN & BROWN, INC.
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Literature Available (Continued)

Equipment Products—Several new machines which have been added to the "Caterpillar" line are illustrated in a new products catalog recently released. Illustrations and complete specifications on diesel tractors, motor graders, engines, along with bulldozers, scrapers, and hydraulic controls will be found in the publication. Ask for Form 12507. **Caterpillar Tractor Co., Peoria 8, Ill.**

Steel Grating—A 24-page, 3-color booklet entitled "Klemp Open Steel Grating" explains and illustrates with actual photographs the different types of grating, flooring, stair treads, and bridge decking. The catalog includes safe load tables; engineering details and layouts; oil company, powerhouse, aluminum sewage disposal, docks, foundries, and atom laboratory installations. **Wm. F. Klemp Co., 6601 S. Melvina Ave., Chicago 38, Ill.**

Flash Mixers & Flocculators—An 8-page, 2-color bulletin entitled "Dorrco Flash Mixers and Dorrco Flocculators" contains photographs and complete descriptions of these units as well as the advantages attending their use. Both are used primarily for the pretreatment of municipal and industrial water supplies, but on ocasion they are also used in sewage treatment. **The Dorr Co., Barry Place, Stamford, Conn.**

Hydroseal Pump—Twelve pages of technical information, illustrations, diagrams, charts, and specifications are offered in an attractive 2-color booklet on Hydroseal pumps. The pump successfully handles water or liquids containing abrasive materials. It also retains its initial efficiency and original discharge for considerable periods with low maintenance costs and satisfactory operation in many installations. **Allen-Sherman-Hoff Co., 225 S. 15th St., Philadelphia, Pa.**

Paving Materials—A 50-page manual has been prepared to cover all of the normal uses of Tarvia road tar, Tarvia-lithic bituminous concrete, and other Barrett paving materials, for highway construction and maintenance. A portion of the manual describes operations and pavement types in which these materials are used. The methods of construction are, necessarily, described in general terms, and local conditions may require modifications. **The Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N.Y.**

Elevated Water Tank—An 8-page pamphlet on the Watersphere, a modern, streamline elevated water tank to provide gravity water pressure for general service and fire protection has been published. The Watersphere is built entirely of steel plates. Butt-welded construction is used throughout. The spherical tank is supported on a single cylindrical column, the flared base of which rests on and is anchored to a circular concrete foundation. The pamphlet contains illustrations of typical installations. **Chicago Bridge & Iron Co., 334 South Michigan Ave., Chicago 2, Ill.**

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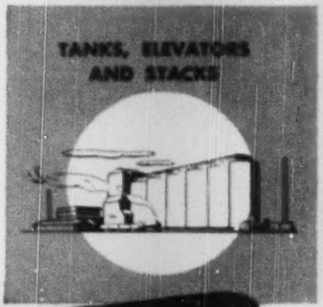

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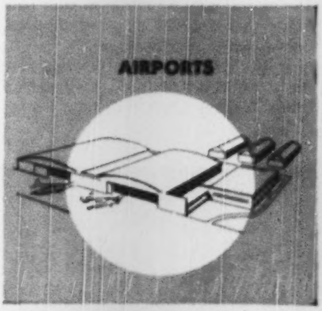

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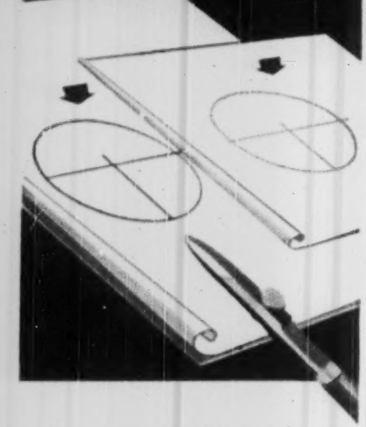

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Literature Available (Continued)

THERMAL INSULATION—44 pages of detailed information on simplified physics of thermal insulation is offered free to engineers, architects and students. Laboratory and actual performance tests are discussed. Diagrams, charts and pictures, as well as a list of typical Infra projects are included in this worthwhile offer. **Infra Insulation, Inc., 10 Murray St., New York 7, N.Y.**

WOOD TREATMENTS—A 3-page set of instructions covering recommendations for buying wood treated with formulations of pentachlorophenol to resist the attack of decay, fungi, wood-destroying insects and dimensional changes caused by excessive moisture or lack of moisture has been issued. The guide covers wood treated by the following processes: pressure treatment, hot and cold immersion, Dri-Vac, cold soaking and dipping. **Public Relations Dept., Dow Chemical Co., Midland, Mich.**

ALUMINUM PRODUCTS—"Revere Aluminum Products" is the title of an informative booklet that contains complete descriptive information about the various forms in which Revere aluminum is fabricated. Included are a large number of illustrations of products using aluminum alloys in the form of extruded shapes, tube, and coiled sheet. Also included is a chart with comprehensive tables giving the properties and characteristics of most of the wrought aluminum alloys. **Revere Copper and Brass, Inc., 230 Park Ave., New York 17, N.Y.**

FIBER FORMS—A 4-page brochure explains the use of the Sonotube as fiber forms for pouring piers, platform supports, columns, underpinning, piles, culverts, storm sewers, and illustrates many of these uses. The Sonotube, which is a practical laminated and impregnated fiber tubing, is available with inside diameters ranging from 3 in. to 24 in. The fiber forms which meet all engineering specifications provide an economical method of constructing concrete forms in that a minimum of bracing is required, and there is a considerable saving over the conventional form. **Sonoco Products Co., Hartsville, S.C.**

CRAWLER TRACTORS—Performance-boosting and cost-cutting features of International crawler tractors are graphically presented in 2 new two-page mailers. A read-at-a-glance explanation of the simple, direct transmission-to-track power train of the typical International, is offered in Form A-420-MM: "Is Your Horsepower Going to the Track?" Exclusive three-point track suspension, for positive alignment and long track service life, is similarly displayed in the folder, "How Long Is Your Tractor's Life Line?" Ask for Form A-419-MM. Copies of the "features-facts" folders are available from **Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

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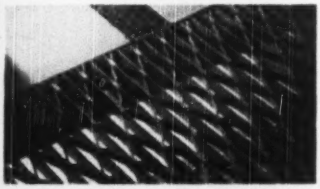

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THE FOLLOWING PAPERS, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in three consecutive issues; others will be added every month, as they become available. Use the convenient order form on page 98.

Closed to Further Discussion

1. **Improvements at the Back River Sewage Works, Baltimore, Md.,** by C. E. Keefer, M. ASCE.

2. **Public Utility Condemnation Cases in the State of Washington** by Henry L. Gray, M. ASCE.

3. **Treatment of Foundations of Large Dams by Grouting Methods** by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Keim, Assoc. M. ASCE.

4. **Capillary Phenomena in Cohesionless Soils** by T. William Lambe, Jun. M. ASCE.

5. **Elastic Restraint Equations for Semi-Rigid Connections** by J. E. Lothers, M. ASCE.

Summarized in Earlier Issues

6. **Slope Deflection Equations for Curved Members** by Keith T. Fowler, Jun. M. ASCE.

7. **The Geochemistry of Earthwork** by Hyde Forbes, M. ASCE.

8. **Floating Tunnel for Long Water Crossings** by Charles E. Andrew, M. ASCE.

9. **Atchafalaya River Diversion and Its Effect on the Mississippi River** by Leo M. Odom, M. ASCE.

10. **Pollution Abatement Policy** by Thomas R. Camp, M. ASCE.

11. **Long-Term Storage Capacity of Reservoirs** by H. E. Hurst.

12. **Influence Charts for Concrete Pavements** by Gerald Pickett and Gordon K. Ray, Jun. M. ASCE.

13. **Reinforced Concrete Skewed Rigid-Frame and Arch Bridges** by Maurice Barron, M. ASCE.

14. **Mathematical Analysis of an Aerial Survey** by Lo-Ho.

15. **Computation of Equitable Charges for Treatment of Municipal Sewage** by Ellis E. Bankson, M. ASCE.

D-VII Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change,** by W. E. Wilson and Laurence G. Olson.

16. **Pavement Bearing Capacity Computed by Theory of Layered Systems** by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE.

17. **Origin and Significance of Openwork Gravel** by Allen S. Cary, Assoc. M. ASCE.

18. **Successive Approximations for Beams on an Elastic Foundation** by E. P. Popov, Assoc. M. ASCE.

19. **Flood-Control Operation of Tennessee Valley Authority Reservoirs** by Edward J. Rutter, M. ASCE.

20. **Three-Dimensional Displacement Diagrams for Space Frame Structures** by Walter Worthington Ewell, Jun. M. ASCE.

Third Notice

21. **Maximum Load Capacity of Bailey Bridges** by Robert B. Stegmaier, Jr., Jun. M. ASCE. Structural sections for standard Bailey bridges were made in large quantities during World War II, by mass production. In military situations, where a bridge was already in place, it was important to know the maximum load capacity so that any necessary added strength could be provided by the most efficient use of available bridging materials. The paper describes the application of test results obtained by loading prototype bridges to failure. Three types of maximum load were established for each type and span of bridge, based on traffic regulations: For control, caution, and risk crossings. For control crossings traffic regulations were liberal. Risk crossings were closely regulated because of the more immediate possibility of failure. The departure from the normal analytical methods for the determination of highway bridge capacity is unusual. The methods described could be applied to any standardized structure. (Available July 1.)

22. **Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy,** Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys. These specifications cover allowable stresses, design rules, and fabricating procedures for riveted heavy-duty structures built of the high-strength aluminum alloy known commercially as 14S-T6. The basic allowable tensile working stress is 22,000 lb per sq in, based on a minimum yield strength of 53,000 lb per sq in. and a minimum tensile strength of 60,000 lb per sq in. The manuscript for the specifications has been approved by the Executive Committee of the Structural Division. (Available July 1.)

23. **Influence of Heavy Loads on Pavement Design Trends** by K. B. Woods, M. ASCE. Data for this paper were obtained from a review of the literature and are evaluated in the light of research at Purdue University in West Lafayette, Ind., on soils, climate, traffic, and materials, since these variables relate to the performance of pavements in primary roads. Emphasis is placed on structural failures of rigid pavements and the rutting of flexible pavements. It is concluded that maximum-weight requirements must be strictly enforced, that the prevailing legal axle-load limits must not be increased, and that large-scale research must be initiated to study the economical design of the truck-pavement combination. Research is also needed to develop better methods of compacting base course materials for flexible pavements; and experimental work is necessary to evaluate the use of thick slabs with heavy reinforcement or the use of slabs with commonly employed thicknesses, constructed with various types and thicknesses of base course. (Available July 1.)

24. **Summary of Buckling of Rigid-Jointed Plane Trusses** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. It is known that the buckling load of a compression member of a framework depends largely on the elastic restraint provided by the adjacent members. Recent investigations have shown that the restraining effect can be calculated rigorously. It is demonstrated that the rigidity of the gusset plates results in a sizable increase in the buckling load. The magnitude of the gusset plate effect can be determined with the aid of the diagrams presented in this paper.

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Experiments are described corroborating the theoretical conclusions. (Available July 1.)

25. Uplift Pressures in Concrete Dams by Kenneth B. Keener, M. ASCE. Measurements of uplift pressures in concrete dams, including analysis and keeping of complete records, are justified. A thorough description is given of the installation and location of equipment used in observing uplift. Methods of relieving excessive foundation uplift pressures are cited. A case history of the uplift at Hoover Dam is included, both *prior* to and after measures were undertaken to reduce foundation pressures. Results of long-time observations at other dams constructed by the Bureau of Reclamation are indicated. It is concluded that design assumptions for uplift more in keeping with actual observations would result in smaller transverse cross sections and thereby in an appreciable reduction in cost of concrete dams. (Available July 1.)

Second Notice

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei. The original paper, published in September 1949 PROCEEDINGS (p. 935), introduced an index of stream flow variability in the form of the standard deviation of the logarithm of the stream discharge. Discussers are: Ven Te Chow, Dana M. Wood, H. Alden Foster, C. S. Ospina and G. Tama, Raphael G. Kazmann, Jack Bruin and H. E. Hudson, Jr., H. W. Lull, William D. Mitchell, C. R. Ownbey, S. P. Wing, J. E. McKee, and G. B. Schroyer and E. T. Schuleen. Mr. Lane wrote the closing arguments, Mr. Lei being inaccessible because of current disturbed conditions in China. (Available August 1.)

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh. The original paper, published in September 1949 PROCEEDINGS (p. 951), presented a method of computing end restraints and the effective lengths of compression members under different load conditions. An important conclusion was that when a truss buckles all members tend to fail simultaneously. Critical and constructive comment was received from Jack R. Benjamin, George Winter, Abraham Slavin, J. Edmund Fitzgerald, Joseph S. Newell, and Charles W. Dohn. The authors' closure should be read with interest by everyone concerned with the practice and theory of structures. (Available August 1.)

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich. The original paper, published in October 1949 PROCEEDINGS (p. 1093), proposed a method for finding the vibration frequencies and modes in three-dimensional structures such as floor systems, multi-story building frames, and airplanes. A brief discussion by Robert V. Hauer, with an answering comment from Mr. Bleich, constitutes the total scope of this Separate. (Available August 1.)

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld. The original paper, published in October 1949 PROCEEDINGS (p. 1133), gave a full description of the construction of 65 lane-miles of roads, within a period of six months. Valuable discussion is presented by P. F. Phelan, which calls for a brief closing comment by the author. (Available August 1.)

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman. The original paper, published in October 1949 PROCEEDINGS (p. 1147), presented general equations for the determination of vertical, torsional, and coupled oscillations on any structural section of two degrees of freedom. Numerical and graphical examples illustrate the practical application of the underlying theory. Discussers are: David J. Peery, Alexander Klemin, Abraham Slavin, Charles W. Dohn, Boris A. Bakhmeteff, F. J. Maher and J. B. Eades, Edmund Pinney, Harold A. Thomas, Elmo G. Peterson, William Allan, Paul Lieber, S. K. Ghaswala, Peter L. Tea, Edward Adams Richardson, H. H. Bleich, F. B. Farquharson, and George S. Vincent. The author's reply is comprehensive and thorough. (Available August 1.)

First Notice

26. Industrial Stream Pollution Abatement, by L. L. Hedgepeth. In the abatement of industrial pollution of streams, a program based on forthrightness, tact, good will, and good faith will be found profitable. This view is derived from Mr. Hedgepeth's 25 years of experience in stream sanitation, in the employment of industry and of the public. The industrial waste problem is so complex as to defy standardization. In support of his recommendations for regulatory measures, Mr. Hedgepeth cites his work on major pollution sources in Virginia in detail. (Available September 1.)

27. Plasticity of Metals—Mathematical Theory and Structural Applications, by D. C. Drucker, Assoc. M. ASCE. A brief analysis is given of the philosophy and practice of engineering design. The importance of plasticity in most elastic design is emphasized and the use of elementary plastic analysis is illustrated. Applications to beam and truss frameworks (limit design and "shakedown") and structural stability are discussed. A short description is given of the development of mathematical theories of plasticity and the experimental results on which they are based. It is demonstrated that some members may load then unload when all forces applied to a structure increase in ratio. (Available September 1.)

28. Retrogression on the Colorado River Since 1935, by J. W. Stanley. Since its construction, Hoover Dam has eliminated the major flood flows from the lower Colorado River, and has trapped all sediment brought down from the upper river. Controlling floods and impounding the sediment, however, do not solve all problems of the lower river. The river bed still scours in some areas and builds up in others, and bank erosion and changing course cause problems at various locations. To watch changes as they occur, and as an aid in planning further physical control, the Bureau of Reclamation has conducted regular surveys along the lower river since 1935. A discussion of these changes is presented in this paper. (Available September 1.)

29. Sedimentation Studies at Conchas Reservoir in New Mexico, by D. C. Bondurant, Assoc. M. ASCE. The importance of sediment deposition in reservoir areas is becoming recognized to an increasing degree, and the problems evolving from sedimentation are now being considered in the planning and design of reservoir projects. Comparative data from existing projects provide the most adequate means for predicting the form and extent of anticipated sediment deposits, since analytical methods for the purpose are yet in the formative stage. The paper presents data on the form and extent of sediment deposits in the Conchas Reservoir together with descriptive data on the contributing drainage. (Available September 1.)

30. Economic Effects of Reservoir Sedimentation, by W. E. Corfitzen, M. ASCE. More storage reservoirs have been created since 1925 than in any period of history, and investigations indicate that sedimentation will limit the useful life of most of them to less than 200 years. Computations of sediment loads and rates and the effects of sedimentation on principal reservoir uses are considered, together with factors involved in computations of the costs of sedimentation. (Available September 1.)

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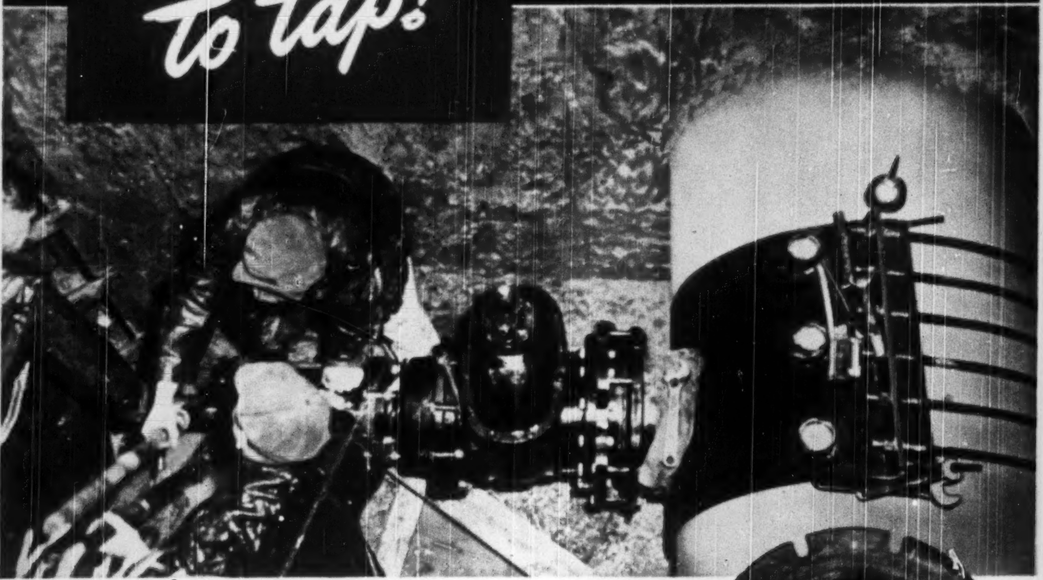

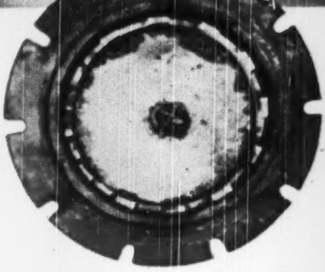

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